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Energy Research Abstracts

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UNITED STATES DEPARTMENT OF ENERGY

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ENERGY RESEARCH ABSTRACTS

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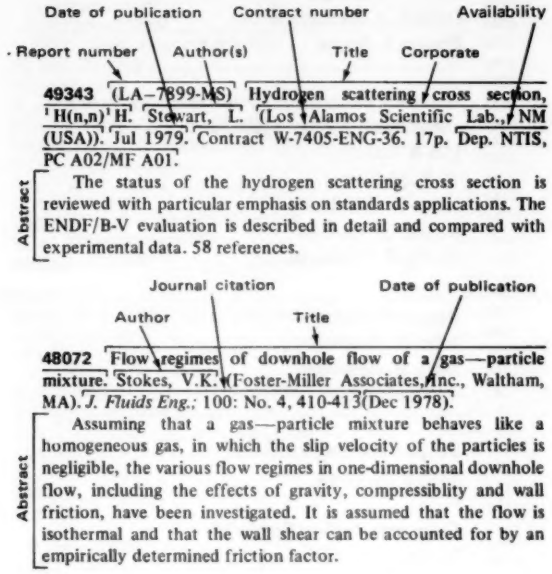
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Availability
Report number
Author(s)
Title
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49343 (LA–7899-MS) Hydrogen scattering cross section, $^1H(n,n)^1H$. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.
Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

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is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, $^1H(n,n)^1H$, 4:49343 (LA–7899-MS)
Low temperature physics and engineering. Quarterly progress report, January 1–March 31, 1979, 4:48988 (LA–7848-PR)

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Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

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HYDROGEN 1 TARGET/NEUTRON REACTIONS
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HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

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W-7405-ENG-36	Los Alamos Scientific Lab., NM (USA)	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore Lab.	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

REFER ALSO TO CITATION(S) 13675

12900 (PB—297343) **Methane-water flow in coalbeds.** Price, H.S. (INTERCOMP Resource Development and Engineering, Inc., Houston, TX (USA)). 7 Apr 1972. Contract S0110752. 78p. NTIS, PC A05/MF A01.

The computer program calculates transient, two-dimensional, gas-water flow in a porous medium. The gas flow obeys laminar Darcy flow. The porosity, permeability, and reservoir thickness can vary with location. A moving boundary can be used to simulate a mine entry advancement. Gas-water relative permeabilities are inputs as functions of water saturation.

PROCESSING

CARBONIZATION

REFER ALSO TO CITATION(S) 12967

12901 **Method of manufacturing green hot briquettes from fine coal for use in shaft furnaces.** Peters, W.; Langhoff, J.; Henkel, S.; Haverkamp, K.D. (to Bergwerksverband GmbH; Rheinstahl Huttenwerke AG). US Patent 4,159,905. 3 Jul 1979. Filed date 24 Jan 1975. 4p.

A method of manufacturing a briquetted coke from fine coal comprises carbonizing the coal at a temperature of from around 600° to 900°C, mixing the carbonized coal with approximately 10 to 80% and preferably from 20 to 40% of fine coal well caking coal, and thereafter hot briquetting the mixture at temperatures of from around 300° to 500°C. A fuel for shaft furnaces preferably includes the use of the hot briquettes as the only solid fuel in the shaft furnace, and it is particularly applicable for blast furnaces.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 13027

12902 (GFETC/RI—79/1) **Reduction of sodium in lignite by ion exchange: a pilot plant study.** Paulson, L.E.; Ellman, R.C. (Department of Energy, Grand Forks, ND (USA). Grand Forks Energy Technology Center). 1979. 54p. Dep. NTIS, PC A04/MF A01.

The variables in removing sodium from lignite by ion exchange were studied in pilot plant tests in which a possible commercial technique was simulated. Data show that sodium was reduced in 1/2 by 0-inch lignite from 7 pct to 3 to 4 pct by contact with a $CaCl_2$ solution for several hours. Sodium is a principle contributor to fireside tube fouling in lignite-burning powerplants. Fouling tendencies using ion-exchanged lignite were markedly reduced.

12903 (LBL—10118) **Coal desulfurization prior to combustion.** Wrathall, J.; Vermeulen, T.; Ergun, S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

Since current coal cleaning processes remove only a fraction of the total sulfur, the question arises as to what fraction of US coals can be cleaned within current EPA new source standards (1.2 lb. SO_2 per MMBTU). A number of studies has shown the fraction to be encouragingly large. A report on the applicability of the Meyers process estimates, on the basis of 35 coals sampled, that 40% of the samples could be burned cleanly after some combination of physical separation and chemical leaching. A report by Ergun on coal cleaning gives the higher estimate of cleanability of 56%, based on 455 samples properly weighted between Eastern and Western coals. Beyond this figure, Ergun estimates an additional 17% is cleanable if 30 to 40% of the organic sulfur is removed, bringing the total cleanable to 73%. Data from a study by Cavallaro, with coal reserves taken from a study by Beekers, give an estimate in agreement with that of Ergun on the amount of coal cleanable by pyrite removal. In summary, cleanable coal reserves increase by 33% if processes are used which can remove what are probably the more reactive organic sulfur species, such as aliphatic mercaptans, sulfides, and disulfides. A process which attacks the refractor thiophenic sulfur could conceivably increase the cleanable coal reserves by another 20 to 30%, assuming roughly equal distribution between reactive and refractory organic sulfur.

12904 (PB—295211) **Reactor test project for chemical removal of pyritic sulfur from coal. volume I. Final report. Final report June 1975-June 1978.** Meyers, R.A.; Santy, M.J.; Hart, W.D.; McClanathan, L.C.; Orsini, R.A. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Jan 1979. Contract EPA-68-02-1880. 277p. NTIS PC A13/MF A01.

The report gives results of an evaluation of the initial performance of the Reactor Test Unit (RTU) for chemical removal of pyritic sulfur from an Appalachian coal. Operation of the plant-from its checkout and shakedown in September 1977 through January 1978--demonstrated that the RTU could be run continuously in three-shift operation to reduce the coal from 2.4 lb SO2/million Btu to a level of 1.0 lb SO2/million Btu, after rinsing and extraction of generated elemental sulfur. There was no measurable coal oxidation during processing and leach rates in the plant were greatly improved over bench-scale values. The leach solution/coal/oxygen environment was found to be corrosive to the installed stainless steel reactor, necessitating future upgrading to support additional testing. Bench-scale experiments showed that the leach solution can be used as a homogeneous dense-media to efficiently gravity-separate coal prior to processing. Beneficial engineering cost improvements are obtained based on using this approach, resulting in capital cost estimates of s68-69/kW and with s0.44-0.50/million Btu processing costs, including amortization of capital, for input coal costing s0.78-0.81/million Btu. Overall energy efficiency was 93-96%.

12905 (PSI-TR—191) **Coal processing for fuel cell utilization: task X. Modeling of condensation phenomena in entrained flow gasifiers.** Lewis, P.; Cronin, J. (Physical Sciences, Inc., Woburn, MA (USA)). Oct 1979. Contract EW-78-A-21-8450. 44p. Dep. NTIS, PC A03/MF A01.

In summary, reasonable estimates of thermodynamic properties and rate constants for chemical reactions have been used to predict the concentration of sulfur, chlorine, potassium and nitrogen species in an environment representative of entrained flow gasifiers. The results of these predictions indicate that the removal of sulfur and chlorine species from the gas phase by the addition of potassium species to the flow and through the heterogeneous condensation of KSH and KCl is feasible. This hot-gas cleanup technique would be compatible with expected molten carbonate fuel cell requirements. The chemistry of NH_3 in entrained flow gasifiers was also analyzed and leads to the conclusion that fuel nitrogen which is released as NH_3 will appear in the product gas as NH_3, with very little reduction due to chemical kinetics. Some correlation between NH_3 removal and NO initial concentration was observed. In conclusion, a well controlled and instrumented experiment to test the concept of hot-gas cleanup of S and Cl by the addition of potassium is needed. Further study of the distribution of particle sizes from gasifiers, their growth, agglomeration and source and removal requirements is needed. The possibility of the removal of fixed nitrogen (NH_3 and HCN) by additives should also be studied.

12906 **Coal desulfurization.** Grant, S.L. (to Standard Oil Co.). US Patent 4,167,397. 11 Sep 1979. Filed date 31 Mar 1978. 8p.

The pyritic sulfur content of coal can be significantly reduced by contacting the coal with an aqueous solution of a salt which increases the dielectric constant of the solution.

12907 **Chemical desulfurization: a misunderstood technology.** George, T.J.; Plants, K.D.; Morel, W.C. (DOE, Process Evaluation Off, Morgantown, WVa). *Coal Min. Process.;* **16**: No. 8, 60-63(Aug 1979).

Chemical coal desulfurization is an emerging technology with potential for removing sulfur while maintaining high "carbon" recovery. But chemical desulfurization costs have not been competitive with conventional coal cleaning or physical beneficiation. However, part of this problem may be that process designers have not properly integrated physical beneficiation technology into desulfurization commercialization concepts. This study shows the cost benefit of integrating physical beneficiation techniques with chemical desulfurization technologies. 5 refs.

GASIFICATION

REFER ALSO TO CITATION(S) 12947, 12962, 12965, 12984, 13001, 13204, 13697

12908 (CONF-791108—15) **Thermodynamically-oriented analysis and heuristic synthesis of a process system-hygas process.** Fan, L.T.; Shieh, J.H.; Shimizu, Y.; Chiu, S.Y. (Kansas State Univ., Manhattan (USA). Dept. of Chemical Engineering; Argonne National Lab., IL (USA)). 29 May 1979. Contract W-31-109-ENG-38. 55p. Dep. NTIS, PC A04/MF A01.

From 72. AICHE meeting; San Francisco, CA, USA (25 Nov 1979).

The concept of thermodynamically-oriented analysis and heuristic synthesis have been applied to a commercial concept design of the HYGAS coal gasification process. The thermodynamic first and second-law efficiencies of the process have been determined to be 67.73% and 62.15%, respectively. It has been identified that the major thermodynamic inefficiencies of this process arise from the gas cleanup unit (unit 7400) and the ammonia unit (unit 5200). The first and second-law efficiencies of the gas cleanup unit are 6.37% and 15.64%, respectively, and those of the ammonia recovery unit are 34.4% and 59.3%, respectively. Three possible configurations of the HYGAS process are compared.

12909 (COO—0003-41-T1) **Synthane pillot plant, South Park Township, Pennsylvania. Final report.** (C-E Lummus, Bloomfield, NJ (USA)). 1979. Contract EY-76-C-02-0003. 548p. Dep. NTIS, PC A23/MF A01.

The Synthane pilot plant was operated by the Lummus Company for the US Department of Energy during the period 1975-1978 to test the feasibility of the Synthane process to produce pipeline quality gas from coal. The Synthane process was developed by the US Bureau of Mines at Bruceton, Pa., now the Pittsburgh Energy Technical Center. The operations of the Synthane pilot plant were suspended in September, 1978. The unit has been mothballed and is presently being maintained in a standby mode. The final report of the operation of the Synthane Pilot Plant represents a summary of various aspects of this project. It contains reports which cover the operation, technical evaluation, and engineering for the period 1976-1978. Additional data on the operation of the Synthane Pilot Plant have previously been recorded in various run reports submitted to the Department of Energy and are available from the National Technical Information Services (NTIS). This Final Report includes an appendix which supplements the individual sections and an index to the library that is part of the Synthane Pilot Plant in Bruceton, Pa. where all documents prepared for the design, engineering, and operation of this facility are filed.

12910 (DOE/EV—10287(Draft)) **Environmentally based siting assessment for synthetic-liquid-fuels facilities. Final report.** (SRI International, Menlo Park, CA (USA)). Jan 1980. Contract AC03-79EV10287. 507p. Dep. NTIS, PC A22/MF A01.

A detailed assessment of the major environmental constraints to siting a synthetic fuels industry and the results of that assessment are used to determine on a regional basis the potential for development of such an industry with minimal environmental conflicts. Secondly, the ability to mitigate some of the constraining impacts through alternative institutional arrangements, especially in areas that are judged to have a low development potential is also assessed. Limitations of the study are delineated, but specifically, the study is limited geographically to well-defined boundaries that include the prime coal and oil shale resource areas. The critical factors used in developing the framework are air quality, water availability, socio-economic capacity, ecological sensitivity, environmental health, and the management of Federally owned lands. (MCW)

12911 (DOE/FE—2210-1) **Connected block and effective conductivity (CONBEC) computer program to predict heat flow through multicomponent refractory lined gasifier vessel walls. Users manual.** Whitacre, G.R.; Grinberg, I.M. (Battelle Columbus Labs., OH (USA)). Jan 1980. Contract EX-76-C-01-2210. 235p. Dep. NTIS, PC A11/MF A01.

CONBEC is a computer programmed model which determines the steady-state heat flow through multicomponent refractory-lined gasifier vessel walls. The model accounts for the effects of lining thickness, porosity, gaps, cracks, refractory composition, physical form, anchor spacing and configuration, gas pressure and composition, and other parameters on heat flow. CONBEC is based on a combination of the CONnected Block and Effective Conductivity techniques. The refractory wall is described as a series of blocks, each with its own effective thermal conductivity. The connected blocks are used to handle nonlinear temperature effects, material difference, and location effects. Parallel heat flow paths through the wall are used to provide for distinct material changes, gaps, conductivity changes, and hot-spot determination. The typical configuration has two parallel heat flow paths. Anchors can be treated as a separate heat flow path or can be left out. The blocks are cross-linked to account for lateral heat flow between the parallel paths. The model is extremely simple to use yet it provides considerable information regarding the importance of material, design, and operational parameters on heat flow in refractory vessel walls and on hot spots. It was developed to be used in the design of material systems for coal gasification vessels and has broad applicability to other refractory linings for furnaces or process vessels.The output results of CONBEC are in good agreement with experimental data obtained for several refractory material systems over a range of wall temperatures, gas compositions, wall thicknesses, crack and gap characteristics, and gas pressures.

12912 (DOE/LETC/B—79/1) **Economic sensitivity study of UCG based on field performance, theory, and operational experience.** Boysen, J.E.; Gunn, R.D. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Nov 1979. 240p. Dep. NTIS, PC A11/MF A01.

This paper provides the results of an economic analysis in which uncertainty has been minimized through the use of the following three types of information: (1) theoretical and experimental correlations of underground coal gasification (UCG) operating parameters; (2) detailed process design based on operational experience; and (3) sensitivity variables. Independent variables cannot be fixed with certainty - for example, gas heating values are known for short-term field tests but remain uncertain for a long-term commercial operation. Such variables are designated sensitivity variables and are over their entire probable range. Other sensitivity variables are percent gas loss, well spacing, and the volumetric combustion sweep efficiency (VCSE). Depth and thickness of the coal seam are also designated sensitivity variables because they are strictly site-specific. A total of 1,296 cases have been considered in order to cover a full range of all sensitivity variables. Only-dirty gas selling prices are calculated in order to avoid assumptions concerning unproven methods of gas cleanup. Results show that the seam depth/thickness ratio is the most important variable affecting the economics of UCG. Low BTU gas from a thick coal seam of moderate depth (30 ft. seam at 600 ft.) can compete with current natural gas prices on a BTU basis even under poor operating conditions such as high leakage and low heating value. Well spacing and gas heating value also have notable impacts on the economics of UCG. The gas leakage rate and VCSE affect the economic results to a lesser extent for the range of values considered. Further research is needed in optimum well spacing, methods for control of the gas heating value, gas cleanup and utilization, environmental impact, and subsidence.

12913 (FE—0497-T9) **Role of the Char-CO_2 reaction in coal gasification. Final report.** Wen, C.Y.; Galli, A.F.; Sears, J.T. (West Virginia Univ., Morgantown (USA). Coll. of Engineering). 1980. Contract EX-76-C-01-0497. 110p. Dep. NTIS, PC A06/MF A01.

The Char-CO_2-CO reaction has been examined on a fundamental basis. Data have been taken in a kinetic regime which are free of interfering effects such as bed effects and particle diffusional effects. Carbon monoxide inhibition was greater at relatively lower temperatures for the char system. An increase in the char reactivity based on remaining char was found during the course of reaction for bituminous, lignite, and subbituminous chars. The effect of particle size on the Char-CO_2-CO reaction was examined. Carbon monoxide inhibition was found to be the same regardless of the particle size. Different pyrolysis techniques were found to lead to different oxygen content and surface area of the chars. Differences in char reactivity due to the char preparation method have been found, and can be explained on the basis of char oxygen content and surface area. Enhanced reactivity from calcium catalytic effects were found to be more pronounced in CO_2-CO gas mixture as compared to effects with pure CO_2. Presence of the calcium decreases the inhibiting effects of CO by affecting the reaction mechanism. Catalysis by CaO is explained by an electron transfer/atomic transfer mechanism

which is consistent with the experimental data. In lignite char the Char-CO_2 reaction cannot be approximated as a first order reaction for coals due to catalysis. In fact, it is more likely to be between zero and first order.

12914 (FE—1207-65(Vol.1)) **Gas generator research and development bi-gas process. Interim report, July 1978-June 30, 1979.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Aug 1979. Contract EF-77-C-01-1207. 388p. (BCR-L—1002(Vol.1)). Dep. NTIS, PC A17/MF A01.

Life tests of catalysts identified by number are reported. The data from PEDU Test No. 30 confirmed that it is possible to operate under conditions of combined shift and methanation for extended periods of time without experiencing catalyst deactivation through carbon formation. The data from PEDU Test No. 31, using the same catalyst charge as used in Test No. 30, were evaluated and again confirmed the feasibility of operating the fluidized-bed methanator at low feed hydrogen-to-carbon monoxide ratios for extended periods of time. In PEDU Test No. 32 the catalyst, a noble metal-promoted nickel catalyst, was the most active of any tested to date. It also showed greater methanation selectivity than the BI-GAS pilot plant methanation catalyst. The data show that with this catalyst it was possible to obtain a product gas meeting pipeline quality specifications in a single pass through the fluidized bed methanator, without the need for polishing methanation (and without the need for secondary carbon dioxide removal). PEDU Test No. 33 reinforced the conclusions from Test No. 32 that the excellent activity and thermal stability of the catalyst are offset by its rather poor mechanical stability. In PEDU Test. No. 34 the carbon content of the catalyst increased from an initial level of 2.6 to a final level of 4.0 percent, and the data from this and previous PEDU tests with this catalyst suggest that significant catalyst deactivation will occur when the carbon content exceeds 3 percent. In PEDU Test No. 35 useful conversions of 98 percent were obtained under these conditions, and, although the final carbon content of the catalyst was 1.4 percent, the catalyst showed no tendency toward deactivation. In PEDU Test No. 36 the thermal stability and attrition resistance of the catalyst were also satisfactory. The catalyst appeared to have potential for use in a combined shift and methanation application, and this will be investigated further.

12915 (FE—1207-65(Vol.2)) **Gas generator research and development bi-gas process. Interim report, July 1978-30 June 1979.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Aug 1979. Contract EF-77-C-01-1207. 156p. (BCR-L—1002(Vol.2)). Dep. NTIS, PC A08/MF A01.

The objective of high-Btu coal gasification is the production of gas containing substantial quantities of methane. An efficient methanation process is essential to the production of such a gas. In the BI-GAS process, a fluidized-bed reactor is employed as the primary methanator. The scientific computer system, MG, utilizes two procedures to estimate the product gas composition obtained from any methanator feed gas; namely, (1) the minimization of the Gibbs free energy of the chemical system, and (2) chemical reaction equilibrium. The former procedure is based on the potential of each gaseous species to react at a given temperature and pressure while the latter focuses on the dominant chemical reactions in the system. Other appendices describe computer calculations: a mathematical model for methanation catalyst selectivity; computer simulation of the BI-GAS process; and computer operations. A bibliography is also appended. (LTN)

12916 (FE—1207-T22) **Bi-gas pilot plant gasifier operation Tests G-3 through G-3G.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Oct 1979. Contract EF-77-C-01-1207. 92p. Dep. NTIS, PC A05/MF A01.

This is the fourth of a series of operating reports to describe pilot plant activities, to present data and conclusions, and to make recommendations appropriate to that operation. This report focuses on the operation of the 2-stage, entrained-bed, high pressure (1500 psig max), oxygen blown, and ash slagging gasifier during eight separate tests (G-3 through G-3G). Subbituminous coal from the Rosebud seam of the Western Energy Company's mine at Colstrip, Montana, was fed to Stage II of the gasifier with Winfield limestone flux during each test. The specific objective of Tests G-3 through G-3G was to determine if slag tapping could be improved if limestone flux was added to the coal feed. Because they shared the same specific objective, Tests G-3 through G-3G were grouped together for presentation. Other objectives are described briefly. With the measures taken during these tests, the slag tapping problems of previous tests were largely overcome. The improved slagging could not be attributed solely to the addition of limestone flux: two other changes had also been made (reduction of water cooling near the tap hole and lengthening of the tap burner) and whether the improved tapping resulted from one or a combination of these changes could not be concluded. The ability to keep the tap hole open did permit tests of longer duration which thereby allowed more of the objectives to be attempted. Although slag tapping was significantly improved, a number of other problems plagued gasifier operation. These included: inadequate solids flow measurement instrumentation, numerous involuntary burner shutdowns, buildups of slag in Stage II, and recurring damage to the burner which resulted in cooling water leaks in Stage I.

12917 (FE—1545-59) **Study of electric plant applications for low Btu gasification of coal for electric power generation. Final report R and D Task 11 (Phase I), July 1974-August 1978.** Hargrove, M.J.; Jack, S.T.; Liljedahl, G.N.; Moffat, B.K. (Combustion Engineering, Inc., Windsor, CT (USA)). Aug 1978. Contract EX-76-C-01-1545. 151p. Dep. NTIS, PC A08/MF A01.

Three 600 Mw electric power plants incorporating C-E low Btu coal gasification at atmospheric pressure are compared. Plant A is a conventional steam cycle; Plant C is a gas turbine/steam turbine combined cycle, with two 1800°F gas turbines and a supplementary fired boiler; Plant D is a combined cycle with four 2200°F gas turbines and unfired boilers. Optimization studies determine the best individual plant schemes. Design and performance of the three plants are discussed. Equipment selections are described for gasification, power production, and balance of plant. Overall operating cost evaluations are developed. The economic effects of changing the product gas heating value by plus or minus 25% are investigated. The Plant A and C power production costs are approximately the same as a new coal fired coventional steam plant with stack gas scrubbers. Plant D's power production costs are 6% lower than those of Plants A, C, or a conventional plant with scrubbers. Therefore, Plant D has excellent potential for the near future coal-fired power plant market, with only a minimum of new technology for the atmospheric pressure gasifiers. In addition, coal gasification power plants A, C and D have the technical potential for meeting future more stringent emission limitations without significant increases in power production costs. The probable future environmental limitations might not be technically attainable by scrubber equipped plants, even with the expenditure of significantly greater funds.

12918 (FE—1548-T2) **Experimental and process design study of a high rate entrained coal gasification process. Final report, January 1974-November 1978.** McIntosh, M.J.; Coates, R.L. (Eyring Research Inst., Provo, UT (USA)). 1978. Contract EX-76-C-01-1548. 415p. Dep. NTIS, PC A18/MF A01.

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Work began in January 1974. The original experimental equipment was designed, fabricated and installed during the first eight months of the project. A total of 296 test runs were made for a total of 800 operating hours. Cold gas efficiencies of 73 percent at specific gasification rates of 115 pounds coal/hour ft^3 atmospheres have been achieved. Extensive equipment modifications have been made to overcome problems encountered. An extended series of runs on a range of feed coals and char were conducted. Using the results a semi-emperical mathematical model was developed. This model incorporated material and energy balances, assumption of frozen water gas shift equilibrium and arrhenius correlations of carbon gasification and methane formation. The Arrhenius constants were found to depend directly on the carbon percentages and the percent volatile matter for the four coals tested. Mathematical models of the entrained gasifier integrated in various ways with a combined cycle system have been developed and used to study the effect of mode of integration, coal type, gasifier heat loss and gasifier steam feed rate on combined cycle performance. The computer programs developed under this task are documented in an appendix. Ford, Bacon and Davis of Utah Inc. performed a detailed cost and engineering analysis of the scaled up high rate entrained gasification process. Their conclusions were favorable and are described in some detail.

12919 (FE—2029-9) **Gasification in pulverized coal flames. Final report (Part I). Pulverized coal combustion and gasification in a cyclone reactor: experiment and model.** Barnhart, J.S.; Laurendeau, N.M. (Purdue Univ., Lafayette, IN (USA). Combustion Lab.). May 1979. Contract EX-76-C-01-2029. 203p. Dep. NTIS, PC A10/MF A01.

A unified experimental and analytical study of pulverized coal combustion and low-BTU gasification in an atmospheric cyclone reactor was performed. Experimental results include several series of coal combustion tests and a coal gasification test carried out via fuel-rich combustion without steam addition. Reactor stability was excellent over a range of equivalence ratios from .67 to 2.4 and air flowrates from 60 to 220 lb/hr. Typical carbon efficiencies were 95% for air-rich and stoichiometric tests and 80% for gasification tests. The best gasification results were achieved at an equivalence ratio of 2.0, where the carbon, cold gas and hot gas efficiencies were 83, 45 and 75%, respectively. The corresponding product gas heating value was 70 BTU/scf. A macroscopic model of coal combustion in the cyclone has been developed. Fuel-rich gasification can also be modeled through a gas-phase equilibrium treatment. Fluid mechanics are modeled by a particle force balance and a series combination of a

perfectly stirred reactor and a plug flow reactor. Kinetic treatments of coal pyrolysis, char oxidation and carbon monoxide oxidation are included. Gas composition and temperature are checked against equilibrium values. The model predicts carbon efficiency, gas composition and temperature and reactor heat loss; gasification parameters, such as cold and hot gas efficiency and make gas heating value, are calculated for fuel-rich conditions. Good agreement exists between experiment and theory for conditions of this investigation.

12920 (FE—2247-24) **Gasification of residual materials from coal liquefaction. Type II Preliminary Pilot Plant Evaluations of SRC-II vacuum flash drum bottoms from Powhatan coal.** Robin, A.M. (Texaco, Inc., Montebello, CA (USA). Montebello Research Lab.). Jul 1979. Contract EX-76-C-01-2247. 34p. Dep. NTIS, PC A03/MF A01.

About 7 1/2 tons of SRC-II vacuum flash drum bottoms from the liquefaction of Powhatan coal were successfully gasified in a 12 ton per day pilot plant. The single fifteen hour run was completed at 24 atmospheres pressure. A 99.5 percent conversion of the carbon in the feed to syngas was achieved, yielding 33.4 SCF of dry syngas per pound of residue charged. The dry syngas contained about 90 (vol) percent carbon monoxide plus hydrogen. About three percent heavy distillate was added to the molten residue to reduce its viscosity to an acceptable level for handling in the pilot plant. Samples of all effluent streams were obtained and sent to Gulf Mineral Resources Company for detailed analyses. The short pilot plant run confirmed the operability of the Texaco Synthesis Gas Generation Process with this feedstock, and the data obtained confirm earlier predictions of performance efficiency. The run consisted of two Type II Preliminary Pilot Plant Evaluations run back to back, thus achieving a single run of twice the normal on stream time for a Type II Evaluation.

12921 (FE—2355-2(Rev.M)) **Coal gasification valves. Phase II. Quarterly technical progress report.** Harper, C. (Consolidated Controls Corp., El Segundo, CA (USA)). Dec 1979. Contract EX-76-C-01-2355. 18p. Dep. NTIS, PC A02/MF A01.

The inlet seat design on the Type I, II, and IV valves has been examined to determine the most expeditious means of eliminating the thermal cracking. Several designs are being evaluated for possible fabrication. Solid (one-piece) gates for both valve types were designed for fabrication from solid alumina ceramic. The one-piece design is slightly smaller than the composite design. Two gates of each type have been ordered. The gate designs were modified to utilize a large, flat wear tile to provide wear protection for the refractory. The Type III gate fabrication problems appear to be resolved. The one-piece alumina ceramic gates offer an additional fabrication method, if successful.

12922 (FE—2434-45-T1) **Pipeline gas from coal: hydrogenation (IGT Hydrogasification Process). Project 70101 quarterly report No. 11, January 1-March 31, 1979.** (Institute of Gas Technology, Chicago, IL (USA)). Oct 1979. Contract EX-76-C-01-2434. 68p. Dep. NTIS, PC A04/MF A01.

The objective of this project is to perform the necessary pilot plant operation and related support studies to acquire data for a commercial/demonstration plant design based on the HYGAS Process. Test 77 was terminated when it became apparent that no trucks would be able to deliver the nitrogen required for high-pressure operation. The reactor operated under self-sustained conditions for 708 hours and 237 tons of coal were fed. A great deal of useful information was obtained. Preparations for Test 78 were completed. The objective of this test was to explore the gasification behavior of ROM coal in the pilot plant at a 500-psig operating pressure, a superficial velocity ranging from 1 to 1.2 ft/s, and using steam feed without nitrogen dilution. Test 78 was concluded at 1000 hours, March 11, because of a leaking valve at the bottom of the feed slurry mix tank and solids transfer problems between the slurry dryer and the LTR in the gasifier. Significant experience was gained operating the coal-handling and pretreatment sections. The pilot plant was thoroughly inspected after Test 78 was ended. The plant was then cleaned and prepared for Test 79 operations. Pretreater and reactor data from Tests 72 and 73 are now available and are presented in this report. Construction work on the new 400-ton coal/char storage system was completed, and shakedown operations were begun.

12923 (FE—2434-49) **Pipeline gas from coal: hydrogenation (IGT Hydrogasification Process). Project 70101 quarterly report No. 12, April 1-June 30, 1979.** (Institute of Gas Technology, Chicago, IL (USA)). Oct 1979. Contract EX-76-C-01-2434. 79p. Dep. NTIS, PC A05/MF A01.

The objective of Test 79 was to examine the gasification behavior of caking bituminous Illinois No. 6 run-of-mine (ROM) coal at a 500-psig reactor operating pressure. The reactor was to be operated under two sets of conditions to achieve char conversions ranging from 85% to 90%. The 400-ton coal/char storage system was used for the first time in Test 79. The test plan was to build up an inventory of pretreated char in the storage system, then heat the reactor and begin char feeding. The plan was executed successfully, and the stored char was used to cover any interruptions in the coal preparation or pretreatment sections. In this manner the reactor was fed at high rates continuously and smoothly in spite of the difficulties inherent in handling ROM coal. Coal crushing and sizing were initiated well in advance of anticipated reactor operation. A number of pilot plant modifications in preparation for Test 79 enhanced pilot plant operation, especially in the coal preparation and slurry preparation sections. The 400-ton coal/char storage system handled, stored, and delivered char easily, thus proving its capability of supporting reactor feeding operations in the long, smooth test operation that followed. Test 79 was highly significant because it was the longest continuous, steady-state HYGAS test ever conducted with this ROM coal. Over 7-1/2 days of continuous feed and a 178-hour steady-state period were logged. Four hundred and sixty-eight tons of pretreated char were processed through the reactor. Reactor results from Tests 75, 76 and 77 are presented in the Appendix, along with overview plots of important reactor variables during these tests.

12924 (FE—2468-70) **ESCOE engineering program. Quarterly report, September 1-November 30, 1979.** (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). 26 Dec 1979. Contract EF-77-C-01-2468. 21p. Dep. NTIS, PC A02/MF A01.

ESCOE is conducting a technical evaluation of materials for energy technology, to prevent major materials and system failures, thereby improving plant operability, and developing materials standards and specifications for coal conversion and use processes. Staff conducted an evaluation of materials of construction for advanced power systems, the third and final, materials area to be examined under this task. A systematic technique is being developed for assessing the opportunities, constraints, costs and impacts associated with the conversion of oil- and gas-fired electric power plants in a single geographic region to coal or coal-derived fuels. The technique is being applied to the New England region. ESCOE is providing continuing support to the MIT effort to develop a complex coal conversion process design simulator assuring efficient coordination between government and private experts. ESCOE is reviewing DOE research and development projects on surface and underground mining to assess their technical feasibility and their region-by-region impact on mining costs and productivity. A comprehensive analysis of the greater use of coal to displace foreign petroleum identified constraints and initiatives and was used to develop a plan for the decade of the 90's that is technically feasible and economically viable.

12925 (FE—2489-48) **Development of combustion data to utilize low-Btu gases as industrial process fuels. Project 61004 final report.** Waibel, R.T.; Fleming, E.S. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1979. Contract EX-76-C-01-2489. 251p. Dep. NTIS, PC A12/MF A01.

Combustion data for three low-Btu gases - along with that of natural gas - demonstrated the feasibility of retrofitting existing burner equipment to the use of low-Btu gases. The low-Btu fuel gases used were Koppers-Totzek oxygen (KTO) (287 Btu/SCF), Wellman-Galusha air (WGA) (160 Btu/SCF), and Winkler air (WA) (116 Btu/SCF). The burners, representing a broad cross section of industrial burner types, were forward-flow baffle, kiln, nozzle-mix, high-forward-momentum, flat-flame, high-excess-air, premix tunnel, and gun-type boiler burner. Except for the kiln and boiler burners, which were scaled-down versions, all of the others were full-scale commercial burners designed for natural gas. Each burner was first fired with natural gas in a pilot-scale furnace with the furnace load adjusted to simulate the conditions under which the burner is typically used. Data were then gathered for each fuel in terms of flame stability, flame length and shape, thermal efficiency, furnace load heat absorption profile, noise level, furnace temperature profiles, radiant heat flux, post-flame emissivities, and flow direction. The 287 Btu/SCF KTO fuel gas compared most favorably with natural gas. KTO fuel gas from an oxygen blown gasifier would make a good substitute when retrofitting burner equipment designed for natural gas. WGA and WA fuel gases from air blown gasifiers are not as good a substitute because of flame stability and thermal efficiency problems.

12926 (FE—2582-T1) **Industrial Fuel Gas Demonstration Plant Program. Quarterly progress report, January-March 31, 1979.** (Memphis Light, Gas and Water Div., TN (USA)). 1979. Contract EF-77-C-01-2582. 72p. Dep. NTIS, PC A04/MF A01.

The status of the U-GAS demonstration plant at Memphis is described: design, site selection and evaluation, environmental effects (management, schedule, water quality, hydrology, ecology, socio-economic factors, noise), permits, equipment license agreements, cost, etc. Recent pilot plant results are also described; extensive tables of data are included. (LTN)

12927 (FE—2666-T2) **Mixing and gasification of coal in entrained flow systems. Quarterly technical progress report No. 9, April 1-June 30, 1979.** Smoot, L.D.; Hedman, P.O. (Brigham Young Univ.,

Provo, UT (USA). Dept. of Chemical Engineering). 15 Jul 1979. Contract EF-77-S-01-2666. 34p. Dep. NTIS, PC A03/MF A01.

This report summarizes work to investigate the mixing and gasification of coal in entrained flow systems. Seven additional check-out tests have been performed with the coal gasification reactor. Tests were performed to investigate isokinetic sampling procedures. Additionally, problems relating to the bursting of the sample bag within the steel sample container, reduction of air contamination of gas samples, quantification of CO_2 absorption in the quench water, and determination of the gaseous sample volume were solved. Analytical chemical procedures using selective ion electrodes were devised to measure the amounts of sulfide, cyanide, and ammonia which are dissolved in the sample probe quench water. Thirteen final cold-flow mixing tests and several check-out tests of the swirl block hardware were conducted. Five tests, which used coal-dust as the particulate phase, completed the set of coal dust tests. Eight tests were conducted with the swirl hardware at the standard test conditions but with the swirl number set to zero; five of these were completed without the quarl installed while three were with the quarl installed. Preliminary analysis indicate that the presence of the swirl generator, even with zero Swirl Number, causes significant increases in the gas mixing rates. Methods of including particle drag effects, and pollutant formation predictions as well as improving the computational efficiency of the one-dimensional code (1-DICOG) have been investigated. The final draft of documentation for the one-dimensional model and a detailed user's manual were completed. Documentation of the two-dimensional, axi-symmetric, gaseous reaction model has also been completed. Extension of this model to coal-fired gasification has continued.

12928 (FE—2729-7) **Alloy catalysts with monolith supports for methanation of coal-derived gases. Quarterly technical progress report, March 21-June 20, 1979.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 5 Jul 1979. Contract EF-77-S-01-2729. 46p. Dep. NTIS, PC A03/MF A01.

Significant progress was made in several task areas, but especially in the investigations of high pressure kinetics and deactivation by sulfur poisoning. Seventeen new catalysts were prepared for use in kinetic studies and long term tests. A number of catalysts were characterized using H_2 and CO adsorption and transmission electron microscopy. Activity tests were conducted for a borohydride reduced catalyst and samples of crushed and uncrushed monolithic nickel catalyst. Extensive kinetic experiments were performed on two monolithic nickel catalysts over a range of temperatures and pressures from which kinetic parameters and a rate expression were obtained. Long term experiments of H_2S poisoning during reaction were also conducted and the data were fitted to a Levenspiel deactivation kinetics model.

12929 (FE—2778-12) **Engineering support services for the DOE/GRI coal gasification research program. Quarterly technical progress report, April-June 1979.** Dover, A.E.; Bostwick, L.E.; Gunderson, J.M.; Castiglioni, B.P.; Hubbard, D.A.; Jacks, J.P.G.; Smith, M.R.; Zeis, L.A. (Pullman Kellogg, Houston, TX (USA)). Aug 1979. Contract ET-78-C-01-2778. 72p. Dep. NTIS, PC A04/MF A01.

Activities consisted of continued monitoring at the Hygas, Westinghouse, Rockwell and Exxon plant sites. Trip reports were issued on BI-GAS Test G-7A, Westinghouse run TP-020-1, and Hygas Test 79. Trips were made to observe parts of Hygas Test 80 and Westinghouse run TP-022-1. Trips were taken to the BI-GAS plant site to discuss items relating to safety. Meetings were held at Rockwell to discuss their plans and design work. A DOE/GRI Operating Committee meeting was held to discuss the Rockwell program. Monitoring of the Bell Aerospace process remains inactive while awaiting contract signing at DOE. Monitoring of the Peatgas work at IGT is being handled by telephone contact and by report review. Preliminary screening evaluation work continues on the Rockwell Hydrogasification, Exxon Catalytic and Westinghouse Fluid Bed processes. The safety assurance study continues on the BI-GAS, Exxon, Rockwell and Westinghouse processes. Consultations on the Westinghouse PDU continue.

12930 (FE—3050-T1) **Study to optimize Cr-Mo steels to resist hydrogen and temper embrittlement. Combined quarterly reports Nos. 1 and 2.** Shaw, B.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 7 May 1979. Contract ET-78-C-01-3050. 44p. Dep. NTIS, PC A03/MF A01.

The first technical report contains a complete description of the program structure and objectives. Two groups of 2-1/4 Cr-1 Mo steel will be characterized for resistance to temper and hydrogen embrittlement: (i) commercial steels provided by the API and (ii) laboratory heats with compositions arranged according to a statistical design. This design and the reasoning for the selected compositions is discussed. The test matrix includes two strength levels: that of normal ASTM A387 pressure vessel steel and that representative of the HAZ adjacent to a weldment. The characterization of the peak hardness in the HAZ is presented in this report. A brief review of the test requirements for measuring K/sub Iscc/ in H_2S is also included.

12931 (GRI—79/0003) **Overview of national research and development activities in synthetic natural gas from coal.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Sep 1979. 64p. NTIS.

The purpose of this report is to provide the Gas Research Institute (GRI) with an overview of activities which are related to GRI's Synthetic Natural Gas (SNG) from Coal Subprogram Area. The information presented is intended to assist GRI in guiding its own research activities an to provide an information base for ensuring that its programs are coordinated with the activities of industry and government.

12932 (METC—8085-T2) **Coal derived fuel gases for molten carbonate fuel cells.** (TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.). Nov 1979. Contract EY-77-C-21-8085. 91p. Dep. NTIS, PC A05/MF A01.

This report characterizes product streams from state-of-the-art and future coal gasification systems to guide fuel cell program planners and researchers in establishing performance goals and developing materials that will be compatible with product gases. Specifically, this report describes: the range of raw-gas compositions available from the major classes of coal gasifiers; the degree of gas clean-up achievable with state-of-the-art and future gas clean-up systems; and the energy penalties associated with gas clean-up. The study encompasses fixed-bed, fluid-bed, entrained-bed, and molten salt gasifiers operating with Eastern bituminous and Western subbituminous coals. Gasifiers operating with air and oxygen blowing are evaluated, and the coal gasification product streams are characterized with respect to: major gas stream constituents, e.g., CO, H_2, CO_2, CH_4, N_2, H_2O; major gas stream contaminants, e.g., H_2S, COS, particulates, tars, etc.; and trace element contaminants, e.g., Na, K, V, Cl, Hg, etc. The results indicate that gasifier product raw-gas compositions are influenced by the gasifier type, operating conditions, and coal type. Fixed-bed gasifiers, that do not subject the coal pyrolysis products to temperatures above approximately 1600°F, contain significant quantities of tars, oils, organic sulfur compounds and organic nitrogen compounds in the product raw gas.Fluid-bed, entrained-bed, and molten salt gasifiers, that operate at higher temperatures, produce less of these materials. Increasing operating temperature also favors the formation of H_2 and CO as compared to CO_2, H_2O and CH_4. Since the presence of H_2 and CO is preferred over CH_4 for a molten carbonate fuel cell feed, high operating temperatures seem to be indicated for gasifiers operating with molten carbonate fuel cells.

12933 (N—78-75465) **A study of the conversion of coal to hydrogen, methane, and liquid fuels for aircraft.** Tsaros, C.L.; Arora, J.L.; Burnham, K.B. (Institute of Gas Technology, Chicago, IL (USA)). Jun 1976. Contract NAS1-13620. 259p. NTIS, PC A12/MF A01.

Depletion of domestic crude oil resources has led to the consideration of alternate fuels derived from more plentiful coal resources. This study addresses the conversion of coal to hydrogen, methane, and synthetic aviation kerosene, for use as alternate aviation fuels. Thermal efficiencies are derived for producing (1) gaseous hydrogen via the Koppers-Totzek, U-GAS, and the continuous Steam-Iron Processes; (2) gaseous methane via the HYGAS and CO2 Acceptor Processes; (3) synthetic aviation kerosene via hydrocracking and aromatic hydrogenation of the heavy fuel oil produced by Consol Synthetic Fuel Process; (4) gasoline via hydrocracking the heavy fuel oil produced by the Consol Synthetic Fuel Process. (The gasoline product would supplement the gasoline produced by a conventional crude oil refinery, thus reducing the amount of light distillate normally catalytically reformed, and thereby freeing a greater amount of light distillate for the manufacture of aviation kerosene.) Process economics are analyzed for all processes except the Koppers-Totzek and CO2 Acceptor Processes.

12934 (PB—292704) **Solids transport between adjacent CAFB fluidized beds. Final report, July 1975—August 1978.** Bachovchin, D.M.; Mulik, P.R.; Newby, R.A.; Keairns, D.L. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Jan 1979. 173p. NTIS, PC A08/MF A01.

The report gives results of an experimental investigation of a pulsed, dense-phase pneumatic transport system for controlled circulation between adjacent fluidized beds. A model was developed to predict performance. The program provides technical support for EPA's program to demonstrate the Chemically Active Fluid Bed (CAFB) Process, being developed to produce a clean, low heating value fuel gas from fossil fuels. A cold model test facility, capable of transporting up to about 6.3 kg/s, was built and operated to demonstrate effects of key parameters. Generated data were utilized in the development of a mathematical model of the system which allows projection of the effects of key variables. Solids flow is controlled by pulsed air input, whose on-time($<$0.3 to 0.4s) and off-time (1.5 to 2.0s) should be controlled for best performance. The system pressure balance should also be carefully controlled. Expected demonstration plant bed-material density may result in higher air requirements than was predicted in the plant design. Wider legs and more nozzles or greater transport-gas capacity may alleviate this difficulty.

12935 (SAND—79-8730) **Alloy selection for sulfidation: oxidation resistance in coal gasification environments.** Bradshaw, R.W.; Stoltz, R.E. (Sandia Labs., Livermore, CA (USA)). Jan 1980. Contract EY-76-C-04-0789. 39p. Dep. NTIS, PC A03/MF A01.

A series of iron-nickel-chromium and nickel-chromium alloys were studied for their combined sulfidation-oxidation resistance in simulated coal gasification environments. All alloys contained a minimum of 20 w/o chromium, and titanium and aluminum in the range 0 to 4 w/o. Corrosion resistance was evaluated at 1255°K (1800°F) in both high BTU and low BTU coal gasification atmospheres with 1 v/o H_2S. Titanium at levels greater than 1 w/o imparted significant sulfidation resistance due to an adherent, solid solution chromium-titanium oxide layer which prevented sulfur penetration. Aluminum was less effective in preventing sulfidation since surface scales were not adherent. Of the commercial alloys tested, Nimomic 81, Pyromet 31, IN801, and IN825 exhibited the best overall corrosion resistance. However, futher alloy development, tailored to produce solid solution chromium-titanium oxide scales, may lead to alloys with greater sulfidation-oxidation resistance than those investigated here.

12936 **Gasification of low quality solid fuels.** Slater, W.L.; Richter, G.N. (to Texaco Inc.). US Patent 4,166,802. 4 Sep 1979. Filed date 20 Apr 1978. 6p.

Low quality solid fuels are gasified by being fed to a gasifier in a concentrated water slurry, the high solids content of the slurry being possible by subjecting the solid fuel to hydrothermal treatment in the product gas quench zone.

12937 **Conversion of solid fuels into fluid fuels.** Schlinger, W.G. (to Texaco Inc.). US Patent 4,158,948. 26 Jun 1979. Filed date 16 Aug 1978. 8p.

Solid carbonaceous fuels are converted into gaseous fuels by a process comprising liquefying at least a portion of the solid fuel, subjecting a portion of the high boiling product to gasification with substantially pure oxygen to provide hydrogen for the liquefaction, subjecting the balance of the high boiling product to gasification with air to provide a gaseous product used as the stripping medium to remove lighter boiling materials from the liquefaction product and recovering fuel gas from the stripping zone overhead.

12938 **Method for combining coal liquefaction and gasification processes.** Schmid, B.K. (to Gulf Oil Corp.). US Patent 4,159,236. 26 Jun 1979. Filed date 12 May 1978. 28p.

Conversion of raw coal to distillate liquid and gaseous hydrocarbon products by solvent liquefaction in the presence of molecular hydrogen employing recycle of mineral residue is commonly performed at a higher thermal efficiency than conversion of coal to pipeline gas in a gasification process employing partial oxidation and methanation reactions. The prior art has disclosed a combination coal liquefaction-gasification process employing recycle of mineral residue in the liquefaction zone wherein all the normally solid dissolved coal produced in the liquefaction zone is passed to a gasification zone for conversion to hydrogen, where the amount of normally solid dissolved coal prepared and passed to the gasification zone is just suficient to enable the gasification zone to produce the exact hydrogen requirement of the process. The present invention provides an unexpected improvement in the thermal efficiency of the combination process by utilizing formulas based on feed coal characteristics to calculate an amount of normally solid dissolved coal to be prepared in the liquefaction zone and passed to the gasification zone to enable the gasification zone to generate not only all of the hydrogen required by the liquefaction zone but also to produce synthesis gas for use as fuel in the liquefaction zone. It would have been expected that shifting some of the processing load from the ordinarily more efficient liquefaction zone to the ordinarily less efficient gasification zone would decrease process efficiency, but the present combination process unexpectedly achieves an overall efficiency increase by said shift.

12939 **Integrated coal liquefaction-gasification process.** Schmid, B.K. (to Gulf Oil Corp.). US Patent 4,159,238. 26 Jun 1979. Filed date 12 May 1978. 26p.

Conversion of raw coal to distillate liquid and gaseous hydrocarbon products by solvent liquefaction in the presence of molecular hydrogen employing recycle of mineral residue is commonly performed at a higher thermal efficiency than conversion of coal to pipeline gas in a gasification process employing partial oxidation and methanation reactions. The prior art has disclosed a combination coal liquefaction-gasification process employing recycle of mineral residue to the liquefaction zone wherein all the normally solid dissolved coal not converted to liquid or gaseous products in the liquefaction zone is passed to a gasification zone for conversion to hydrogen, where the amount of normally solid dissolved coal passed to the gasification zone is just sufficient to enable the gasification zone to produce the process hydrogen requirement. The process of the present invention provides an unexpected improvement in the thermal efficiency of the combination process by increasing the amount of normally solid dissolved coal prepared in the liquefaction zone and passed to the gasification zone to enable the gasification zone to generate not only all of the hydrogen required by the liquefaction zone but also to produce synthesis gas in an amount adequate to supply all or a significant amount of the fuel requirements of the process. It would have been expected that shifting some of the processing load from the ordinarily more efficient liquefaction zone to the ordinarily less efficient gasification zone would decrease process efficiency, but the present combination process unexpectedly achieves an overall efficiency increase by said shift.

12940 **Coal liquefaction process employing fuel from a combined gasifier.** Schmid, B.K. (to Gulf Oil Corp.). US Patent 4,159,237. 26 Jun 1979. Filed date 12 May 1978. 26p.

Conversion of raw coal to distillate liquid and gaseous hydrocarbon products by solvent liquefaction in the presence of molecular hydrogen employing recycle of mineral residue is commonly performed at a higher thermal efficiency than conversion of coal to pipeline gas in a gasification process employing partial oxidation and methanation reactions. The prior art has disclosed a combination coal liquefaction-gasification process employing recycle of mineral residue to the liquefaction zone wherein all the normally solid dissolved coal produced in the liquefaction zone is passed to a gasification zone for conversion to hydrogen, where the amount of normally solid dissolved coal passed to the gasification zone is just suficient to enable the gasification zone to produce the process hydrogen requirement. An unexpected improvement in the thermal efficiency of the combination process is achieved by increasing the amount of normally solid dissolved coal prepared in the liquefaction zone and passed to the gasification zone to enable the gasification zone to generate not only all of the hydrogen required by the liquefaction zone but also to produce excess synthesis gas for use as process fuel. The gasification zone operates with steam and oxygen injection rates resulting in elevated temperature in the range 2200° to 2600°F which enhance thermal efficiency by accomplishing nearly complete oxidation of carbonaceous feed. These high temperatures produce a synthesis gas relatively richer in CO than H_2. Because the synthesis gas is utilized as fuel, hydrogen can be recovered from the synthesis gas without degrading the value of the remaining CO-concentrated steam, since the combustion heating value of a concentrated CO steam is about the same as that of an H_2-rich synthesis gas.

12941 **Costs of synthetic fuels from coal: a methodology.** Jones, J.E.; Nicholson, A.F. (Kentucky Center for Energy Research, Lexington). pp 43-51 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

An attempt is made to demonstrate a cost methodology that will provide useful estimates of synthetic fuel costs. Specifically, cost studies of the low-Btu gasification process are presented. Synthetic fuel cost estimates involve careful analysis of investment cost, operating rate, operating costs, conversion efficiency, and a reasonably sophisticated model to allocate and levelize the capital charges over the life of the project. It is seen from the sensitivity analysis of low-Btu gas that high operating rate and high conversion efficiency are the essential factors of reasonably priced synthetic fuels. (MCW)

12942 **Review of regional gasification and liquefaction projects.** Neworth, M. (Dept. of Energy, Washington, DC). pp 53-55 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

The Department of Energy coal conversion program is designed to meet short- and long-term objectives. Low- and medium-Btu gas offer the most-economic substitutes for natural gas in the industrial fuel market, and ultimately as a means of clean electric power generation from coal. DOE is developing three second-generation coal-liquefaction processes, all of which have commercial potential by the mid-1980s, as a means of reducing the nation's dependence on imported oil. Information on the individual projects is briefly given. (MCW)

12943 **Waste heat from coal-conversion processes.** Eaton, T.E. (Univ. of Kentucky, Lexington); Gentry, E.L. pp 67-77 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

Coal-conversion-plant designs were surveyed to determine heat-rejection rates and water requirements, as well as heat-rejection-system design. Typically, coal-conversion plants operate at fuel thermal-conversion efficiencies ranging from 55 to 75% and require over 60 gal of water per million Btu of product fuel. Heat-rejection requirements from a coal-conversion process were established to be similar to those of a large petroleum refinery and markedly different

from those of an electrical-generating station. The heat-rejection systems, as currently designed, follow conventional process-cooling design. More than one-half of the water consumed in coal conversion is used for plant cooling systems. Importantly, because the low sink temperature is not necessary for many cooling loads, the potential for utilizing waste heat from coal-conversion processes is more promising than with power-conversion cycles. 49 references.

12944 Economic evaluation of the ATC/Wellman incandescent two-stage low-Btu coal gas producer. Moore, C.K.; Jarvis, J.S. (Applied Technology Corp., Houston, TX). pp 91-103 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

The most realistic answer to the energy needs of US industry is coal. The US has vast supplies of this energy source that needs only development. The construction of new equipment or the conversion of old equipment may be economically unsound and in many process usages, gaseous fuel is imperative. Coal gasification is the answer. The ATC/Wellman gas producer basically is a simple, efficient, commercially proven process for the conversion of a wide variety of coals into a fuel gas. It is essentially a closed combustion chamber that completes this conversion with efficiencies approaching 90%. With the current gas shortage, the need for dependable economical gas supplies and America's large supply of coal makes the Wellman unit an attractive alternative to undependable natural gas for the industrial user. The process is described and evaluated. (MCW)

LIQUEFACTION

REFER ALSO TO CITATION(S) 12910, 12920, 12924, 12933, 12937, 12938, 12939, 12940, 12942, 12943, 13002, 13003, 13884, 13885

12945 (FE—1517-57) **Refurbishing of the Cresap test center. Interim report, May 1974-September 1977.** (Fluor Engineers and Constructors, Inc., Irvine, CA (USA)). Aug 1978. Contract EX-76-C-01-1517. 252p. NTIS, MF A01.

Portions of document are illegible.

The pilot plant at Cresap, West Virginia was originally set up as a project to produce high octane gasoline from coal. The design was accomplished by the C.W. Nofsinger Company under contract to the Consolidation Coal Company, and construction was completed in 1967 by the Dravo Company. The plant operated until April, 1970. It was plagued throughout its operating life by numerous mechanical failures. Subsequent to the shutdown, an engineering survey was made by the Foster-Wheeler Corporation, who concluded that the process was technically feasible but that certain design modifications of the pilot plant were necessary to improve mechanical reliability. Fluor was awarded a contract in May, 1974 to reactivate the plant. The Consol Synthetic Fuels (CSF) process was retained as the basic design, but the target product specifications were shifted from a light synthetic crude oil to a clean liquid fuel suitable for large stationary steam boilers such as are used in the electric power generation industry. The plant has been modified to incorporate an extensive testing program to establish the reliability of equipment components critical to coal liquefaction processes. This report provides a detailed analysis of the plant changes needed to meet the contractual objectives. In addition, this report contains a process description, process and mechanical flow diagrams, an equipment list, and photographs of the plant site at various stages of the construction.

12946 (FE—1743-72) **Zinc halide hydrocracking process for distillate fuels from coal. Quarterly technical progress report, February 1-April 30, 1979.** Pell, M.; Greene, C.R.; Maskew, J.T.; Zielke, C.W.; Struck, R.T. (Conoco Coal Development Co., Library, PA (USA)). 29 Jun 1979. Contract EX-76-C-01-1743. 56p. Dep. NTIS, PC A04/MF A01.

The Hydrocracking Section of the 1.2 TPD (45 kg/h) PDU completed a program feeding SRC-I with recycle of all +200°C distillate. As expected from smaller-scale work, a gasoline yield of 49% was obtained, corresponding to 67% if all +200°C were recycled to extinction. The final research octane number was down from 93 to 87, indicating that conditions were slightly too severe to produce the desired 90-92 RON. The Regeneration Section of the PDU is being revised to upgrade melt handling and is on schedule. The laboratory study of the effect of ash metal chlorides on catalyst activity concludes that the build-up of KCl, NaCl, $CaCl_2$ and $FeCl_2$ should be limited by equilibria involved to levels where the reduction of catalyst activity will be small. An economic estimate for a commercial plant making 53,000 bbl/SD (8.4 x 10^6 liters/SD) of gasoline from Western coal projects gasoline costs which encourage further development of the process.

12947 (FE—2006-15) **Applied research and evaluation of process concepts for liquefaction and gasification of western coals. Quarterly progress report, January-March 1979.** Wiser, W.H. (Utah Univ., Salt Lake City (USA). Dept. of Mining and Fuels Engineering). Jul 1979. Contract EX-76-C-01-2006. 109p. Dep. NTIS, PC A06/MF A01.

Progress to date is summarized. Hydrotreated SRC liquids undergo smooth catalytic cracking at 325 to 425°C to yield light liquid products with little gas and coke formation. The cracking reaction can be controlled to yield gasoline-range products. Increasing the temperature of the carbon monoxide hydrogenation reaction over iron-manganese catalyst increased the olefin selectivity and reduced methane production. At constant conversion the olefin selectivity increased with increasing space velocity and decreased with increasing H_2/CO ratio. The C_2-C_4 hydrocarbon yield is insensitive to process changes at constant temperature and conversion. At constant temperature the olefin selectivity increased with increasing space velocity and decreased with increasing H_2CO ratio.

12948 (FE—2007-T1) **Filtration process and equipment studies for coal liquefaction processes. Final report.** Bastidas, I.; Himes, R.C.; Hutto, F.B.; Martin, P. (Johns-Manville Sales Corp., Denver, CO (USA)). May 1979. Contract EX-76-C-01-2007. 217p. Dep. NTIS, PC A10/MF A01.

Precoat filtration has been used as the liquid/solid separation process at both the Pittsburg and Midway Coal Mining Company, Fort Lewis, Washington, SRC I Pilot Plant and the SRC Pilot Plant at Wilsonville, Alabama. Johns-Manville's experience from other precoat filtration operations indicated that major improvements in filtration rate and operating costs should be possible. A Rotary Pressure Precoat Filter Test Leaf was designed and constructed which makes it possible to simulate the operation of a full scale rotary pressure precoat filter. Variables affecting the operation of the rotary pressure precoat filter were investigated in detail. At optimized operating conditions, the filtration rates were three to four times those achieved at Fort Lewis and almost an order of magnitude higher than those obtained at Wilsonville on another type of filter. It now appears possible to markedly reduce the filtration cost in coal liquefaction plants. This Report includes a review of precoat filtration principles, a description of the test equipment used, and a presentation of the effect of filtration variables as determined by studies with the Rotary Pressure Precoat Filter Test Leaf.

12949 (FE—2274-7) **Optimization studies of various coal-conversion systems: coal dissolution phenomena. Interim report, April-December 1978.** Wen, C.Y.; Han, K.W. (West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering). 1978. Contract EX-76-C-01-2274. 199p. Dep. NTIS, PC A09/MF A01.

An investigation of the bituminous coal dissolution phenomena has been undertaken in order to develop information which would be useful in the design and scale-up considerations for a commercial liquefaction plant. The experimental data of this study were derived from pilot plants using various coal liquefaction processes. The data were analyzed in order to better understand the phenomena which occur in the preheater and reactor sections during the liquefaction of coal. Two different stages were found to exist in the coal dissolution reactions. In the initial stage of coal dissolution, a first-order reaction scheme is proposed, whereby coal undergoes a fast thermal reaction producing preasphaltene as the predominant product. Conversion for this reaction is calculated based on the amount of pyridine solubles formed. The rate coefficient for this stage is found to follow an Arrhenius type temperature dependence with an activation energy of 48 ~ 55 Kcal/g-mole. In the second stage of coal dissolution, a slower first-order rate expression is proposed in which the preasphaltene is converted to benzene solubles with subsequent rehydrogenation of the coal-derived solvent. A semi-empirical correlation for the dissolution rate coefficient in the second stage reaction is presented, which reasonably accounts for the effects of temperature, hydrogen partial pressure and of particular importance - reactor hydrodynamics. However, the rate coefficient was found to be practically independent of coal particle size. Finally, the rate of hydrogen absorption during coal dissolution is modeled by assuming that the gas and liquid phases are in equilibrium at the interface. The overall gas absorption coefficient was found to be a function of superficial gas velocity.

12950 (FE—2514-M3) **Developmental research program for clean industrial and transportation fuels from coal. Milestone report on process variable studies, July 1978-February 1979.** Schindler, H.D.; Long, R.H. (Lummus Co., Bloomfield, NJ (USA)). Jun 1979. Contract EF-76-C-01-2514. 66p. Dep. NTIS, PC A04/MF A01.

In this subtask covering a study of process variables, a series of eight runs were made at two levels each of temperature (820/840°F), pressure (2100/2700 psig), and coal space rate (1.6/2.5 lbs coal/hr/lb catalyst), using a 35 weight percent coal paste feed. A ninth run on this feed was performed at a temperature of 850°F, 2700 psig, and a coal space rate of 2.5 lbs/hr/lb catalyst. Three standard condition runs using a 30 weight percent coal feed at 830°F, 2100 psig, and a coal space rate of 1.6 lb/lb-hr were interspersed to monitor catalyst deactivation, completing the group of

twelve runs which covered the effects of the three variables indicated. Nalco Spherocat 502 8/12 mesh spherical nickel/molybdenum catalyst was used. The balance of the subtask effort pertained to establishing the effect of the high viscosity feed in the first reactor on bed expansion in terms of establishing a limiting throughput. The hydroliquefaction conditions were 830°F and 2100 psig, with a 30 weight percent coal paste as feed. A severity factor was developed to correlate hydrogen consumption as a function of reaction pressure, temperature, and coal space rate which provides a good correlation for most of the results.

12951 (FE—2537-10) **Consequences of the mass spectrometric and infrared analysis of oils and asphaltenes for the chemistry of coal liquefaction. Characterization of coal-derived liquids and other fossil fuel related materials employing mass spectrometry.** Benson, P.A.; Scheppele, S.E.; Greenwood, G.J.; Aczel, T.; Grindstaff, Q.G.; Beier, B.F. (Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry; Exxon Research and Engineering Co., Baytown, TX (USA); Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Sep 1979. Contract EX-76-S-01-2537. 120p. Dep. NTIS, PC A06/MF A01.

A COED liquid was separated into oils, asphaltenes, and residue. Anion- and cation-exchange chromatography fractionated the oils and asphaltenes into acids, bases, and neutrals; silica-gel chromatography separated neutral fractions into saturate and aromatic concentrates. Infrared spectra of the aromatic concentrates identified functional groups. Carbon-number distributions for the aromatic concentrates were obtained using high- and low-resolution FI/MS and high-resolution 70-eV EI/MS and ultra high-resolution low-voltage EI/MS. Excellent agreement exists between the MS analyses. The asphaltenes contain higher molecular weight Z series, higher molecular weight homologs and different compound types than do the oils. However, compound types are observed in both fractions which are equivalent in molecular formula and, hence, assumably in molecular structure. Furthermore, the overlap in compositions is appreciable. Although oils and asphaltenes are generally considered to be key intermediates in coal liquefaction, our results show that simple solvent extraction produces compositionally non-unique fractions. Thus, detailed molecular analysis is a prerequisite for the correct assessment of (1) reaction conditions and catalyst on the mechanism and kinetics of coal liquefaction and (2) alteration in process conditions on the quality of the coal liquid.

12952 (FE—2566-30) **Upgrading of coal liquids. Hydrotreating and fluid catalytic cracking of EDS process derived gas oils. Interim report.** Riedl, F.J.; deRosset, A.J. (UOP, Inc., Des Plaines, IL (USA). Corporate Research Center). Aug 1979. Contract EF-77-C-01-2566. 54p. Dep. NTIS, PC A04/MF A01.

The objective of this work was to evaluate the applicability of commercial UOP hydrotreating and fluid catalytic cracking (FCC) processes to distillate liquids derived from the Exxon Donor Solvent (EDS) process. Feedstocks were derived from the 400 to 1000°F (204-538°C) fraction of the new EDS product. Five different feedstocks, ranging in hydrogen content from 7.41 to 11.95 wt % were prepared by batch vacuum flash distillation or by catalytic hydrotreating in research pilot plants. Rerunning the raw feed to remove 18.7 wt % bottoms failed to eliminate heptane insolubles. Therefore, a UOP black oil conversion catalyst, known to be effective in reducing heptane insolubles, was selected for hydrotreating the raw stock. Results of fluid catalytic cracking in a research scale riser cracker unit showed that feed hydrogen content is a dominant factor in conversion and yield structure. Hydrotreating substantially improved the cracking characteristics of the EDS liquid product. As more hydrogen was added, conversion and gasoline yield increased and carbon deposition decreased. Gasoline research octane numbers of 95-101 were obtained. Cycle oils containing 650°F⁻ distillate as high as 85 vol % were generated. The lighter portions of the cycle oil, boiling between 400 to 650°F, are valuable components of distillate fuels and heating oils. It is concluded that, with an appropriate degree of hydrotreatment, the EDS process derived gas oil, or any other coal derived distillate of similar quality, can be readily processed into high quality gasolines by applying advanced commercial fluid catalytic cracking technology. The fluid catalytic cracker, in conjunction with a hydrotreater, shows potential to play a major role in future commercial refining of coal derived liquids.

12953 (FE—2588-22) **Study of ebullated bed fluid dynamics for H-Coal. Quarterly progress report No. 6, March 1-May 31, 1979.** Vasalos, I.A.; Bild, E.M.; Rundell, D.N.; Gorman, J.W. (Amoco Oil Co., Naperville, IL (USA). Research and Development Dept.). Jun 1979. Contract EF-77-C-01-2588. 98p. Dep. NTIS, PC A05/MF A01.

The H-Coal process, developed by Hydrocarbon Research, Incorporated (HRI), involves the direct catalytic hydroliquefaction of coal to low-sulfur boiler fuel or synthetic crude oil. The H-Coal ebullated bed reactor contains at least four discrete components: gas, liquid, catalyst, and unconverted coal and ash. Because of the complexity created by these four components, it is desirable to understand the fluid dynamics of the system. The objective of this program is to establish the dependence of the ebullated bed fluid dynamics on process parameters. This will permit improved control of the ebullated bed reactor. The work to be performed is divided into three parts: review of prior work, cold flow model construction and operation, and mathematical modeling. The review of prior work has been completed. The objective of this quarterly progress report is to outline progress in the second and third parts of the project.

12954 (FE—2645-03) **Deasphalting, deashing, and upgrading of coal liquids. Quarterly technical progress report, April-June 1979.** Riedl, F.J.; deRosset, A.J. (UOP, Inc., Des Plaines, IL (USA). Corporate Research Center). Jul 1979. Contract ET-78-C-01-2645. 23p. Dep. NTIS, PC A02/MF A01.

Deashing of UOP coal liquefaction product, using the UOP Demex process, has been completed. Three rejection levels of 17, 30 and 26 wt % were attained. Ash content of the composite product was < 20 ppM. Fixed bed hydrotreating of the deashed oil was completed. A 0.75 wt % increase in hydrogen content was obtained under relatively mild operating conditions. A second coal liquefaction operation was completed, using the hydrotreated deashed oil as solvent. A 90 to 93 wt % (MAF basis) coal conversion was achieved. Demex deashing of this second liquefied coal product is to be started in July.

12955 (FE—2727-7) **Mass transport characteristics of zeolite cracking catalysts. Quarterly report, April 1-June 30, 1979.** Haynes, H.W. Jr. (Mississippi Univ., University (USA). Dept. of Chemical Engineering). 1980. Contract EF-77-S-01-2727. 58p. Dep. NTIS, PC A04/MF A01.

Previous reports have pointed out the discrepancy between our n-butane/NaY diffusivity measurements and the linear chromatography theory. A series of experiments has been completed which clearly demonstrates the existence of nonlinearities in this system. A similar discrepancy is evident in the system n-hexane/NaY. In contrast, the results for diffusion of 2,2-dimethylbutane, cyclohexane and t-decalin in zeolite NaY at 280°C are well described by the theory. Surprisingly, no diffusion effects are observed in these systems. The diffusion is too rapid to be detected. The cracking of decalin and other hydrocarbons over various acid forms of zeolite -Y has been studied. Arrhenius plots of the first order rate constant for decalin conversion exhibit well-defined breakpoints indicative of a transition from the kinetics regime to an intracrystalline diffusion regime. By setting the Thiele modulus equal to unity at the breakpoint it is possible to estimate the diffusivity. This appears to be the first time that values of intracrystalline diffusivity have been reported for a species in a reaction environment. A series of hydrocracking studies over a NiWHUSY zeolite has been completed. Some problems were experienced with temporary plugging during hydrogenated pyrene runs, and the carbon material balances were rather poor. Excellent material balances were obtained during the tetralin runs. The catalyst is quite active for conversion of the hydrogenated pyrenes despite the large molecular size. An analysis of the kinetics is underway.

12956 (FE—2745-T1) **Development of high-pressure, stirred, near-plug flow laboratory reactor for coal liquefaction. Annual report, August 15, 1977-August 14, 1978.** White, D.H. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). Jan 1979. Contract EF-77-G-01-2745. 89p. Dep. NTIS, PC A05/MF A01.

The research in progress is developing a high-pressure, stirred, near-plug flow laboratory reactor, capable of handling more dense and more viscous slurries over a wider range of flow velocities than possible in the coventional unstirred tubular reactor. An existing plasticating extruder, complete with instrumentation and data logging by a minicomputer, was modified by adding pressure slurry feed, redesigning existing screws, and providing certain sampling and safety devices. The unique character of flow of the extruder was retained, namely, handling a dense slurry, generating pressures to more viscous liquids and slurries, providing internal mixing by the screw, and maintaining this flow in a near-plug condition as proven by its narrow residence time distribution (RTD). Data was taken upon the performance of the modified extruder for handling coal/oil slurries, including concentrations, pressure and temperature profiles along the screw, the RTD by radioactive tracer technique to determine the closeness of plug flow, the degree of internal mixing by RTD correlations and experiments on axial dispersions, and some laboratory rheological properties of the slurries utilized. Coal/gear oil slurry concentrations up to 60 weight percent coal were handled without difficulty. Recommendations were made upon the design of a laboratory reactor based upon these results. The reactor under development is unique in that it can handle concentrated coal slurries under high pressures in a mixed, near-plug flow condition.

12957 (FE—2893-35) **EDS Coal Liquefaction Process Development. Phase IV. Annual technical progress report, July 1, 1978-June 30, 1979.** Epperly, W.R. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Sep 1979. Contract EF-77-A-01-2893. 516p. Dep. NTIS, PC A22/MF A01.

Development of the EXXON EDS Coal Liquefaction Process during the past year included: construction and operation of coal liquefaction pilot plants to optimize conditions and evaluate different coals, further studies on hydrogenation of organic, bench-scale experiments, mathematical model development, correlations, product quality and performance studies, market studies, stability of coal liquid product in storage, coking and gasification of residues, commercial plant design and economic analysis, etc. (LTN)

12958 (FE—2893-36) **EDS Coal Liquefaction Process Development. Phase IV. EDS commercial plant study design update. Onsite design basis: Illinois Coal Market Flexibility Sensitivity Case. Interim report.** Epperly, W.R. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Jul 1979. Contract EF-77-A-01-2893. 24p. Dep. NTIS (US Sales Only), PC A02/MF A01.

This document sets forth changes to the Revised Onsite Design Basis for the Illinois Coal Base Case to describe the Market Flexibility Sensitivity Case. The Illinois Coal Market Flexibility Sensitivity Case is based on producing hydrogen by partial oxidation of vacuum bottoms instead of steam reforming of methane, ethane and propane (as in the base case). The methane/ethane product released by elimination of steam reforming is to be sold as high Btu gas (HBG). HBG will also be used as backup fuel in the fuel system. The Sensitivity Study Design will have two (instead of three) FLEXICOKING units to produce low Btu gas (LBG) for plant fuel. The total vacuum bottoms feed rate to FLEXICOKING is only about 50% of the rate in the Base Case, because about 50% of the plant vacuum bottoms are fed to partial oxidation to produce H_2. The plant is still in fuel balance with LBG because the onsite fuel requirements are much lower than in the Base Case due to the absence of steam reforming which uses about 60% of the onsite plant fuel in the base case. The FLEXICOKING units provide onsite LBG fuel needs plus some spillover to offsite steam boilers. Some other changes resulting from the economic analysis are described.

12959 (FE—2893-38) **EDS Coal Liquefaction Process Development. Phase IV. Monthly technical progress report, July 1-31, 1979.** Epperly, W.R. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Aug 1979. Contract EF-77-A-01-2893. 64p. Dep. NTIS (US Sales Only), PC A04/MF A01.

The operation of pilot plants for parameter optimization and evaluation of different coals is described. This included vacuum bottoms recycle operations; since this CLPP pilot was not achieving expected results, a research program was initiated to investigate the chemical structure of the liquefaction bottoms. Work is continuing on the economics analysis and design of a commercial plant case design. Various computer calculations, mathematical models and material balance studies in support of this are described - procurement for and construction of the ECLP pilot plant are discussed. (LTN)

12960 (FE—3048-3) **Molten alkali metal hydroxide catalyzed coal liquefaction. Quarterly technical progress report, April-June 1979.** Skowronski, R.P.; Heredy, L.A. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Jul 1979. Contract ET-78-C-01-3048. 41p. Dep. NTIS, PC A03/MF A01.

This is the third quarterly report on the investigation of a molten, alkali-metal-hydroxide-catalyzed coal liquefaction concept. The approach emphasizes maximizing liquid yields, especially distillate liquids, maximizing heteroatom removal, and minimizing gas production and hydrogen consumption. The effort consists of a laboratory test program to evaluate coal feedstocks, determine the effects of eight operating parameters on the production of liquids, and evaluate potential materials of construction. This quarter's liquefaction experiments have emphasized the fact of low catalyst-to-coal ratio. The experiments using low emounts of catalyst have indicated that impregnation is not an advisable method of contacting the coal with the catalyst. Other methods of contacting, such as coal injection, are presently being tested. We have developed a coal injection system coupled with rapid cooldown techniques and have demonstrated that a well defined reaction time can be obtained. The corrosion test will provide information on the corrosion-resistance of several Inconel alloys in sulfur-containing molten alkali metal hydroxide under coal liquefaction conditions.

12961 (LBL—10282) **Coal liquefaction using zinc chloride catalyst in an extracting solvent medium.** Gandhi, S.A.; Bell, A.T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 97p. Dep. NTIS, PC A05/MF A01. Thesis.

Coal liquefaction was studied in a stirred autoclave using zinc chloride catalyst in a cyclohexane solvent medium. Three different coals were investigated: SRC-I, Wyodak subbituminous coal, and Illinois # 6 bituminous coal. Studies on the effect of reaction time indicate that the solubility of Wyodak coal increased linearly up to 2 hours, while the solubility of SRC-I was nearly constant after 1 hour. Increasing reaction temperature from 250°C to 400°C was found to linearly increase the yield of soluble products. Hydrogen pressure had a lesser effect on the yield, but the presence of gaseous hydrogen was necessary to produce a high cyclohexane solubility. Studies with co-catalysts indicated that Zn metal, NiS, and $AlCl_3$ in combination with zinc chloride were all incapable of increasing the yield of oil like products. In contrast, Ni metal acted more favorably and increased yields were obtained using $Ni/ZnCl_2$ catalyst mixtures. Methanol, ethanol, and isopropanol additives in the presence of zinc chloride increased the solubility of coal in cyclohexane. Further studies revealed that pre-impregnation of the catalyst into the coal from methanol solution was unnecessary and that catalyst to coal contacting did not limit the rate of reaction. Studies on the effect of solvent volume indicated that increasing the solvent/coal ratio had no effect on the reaction yield. Finally, the use of benzene as the extracting solvent resulted in higher yields of extractable products, exhibiting lower H/C and H/sub al//H/sub ar/ ratios compared to cyclohexane extracts.

12962 (ORNL—5635) **Assessment of advanced process concepts for liquefaction of low H_2:CO ratio synthesis gas based on the Koelbel slurry reactor and the mobil-gasoline process.** Poutsma, M.L. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 47p. Dep. NTIS, PC A03/MF A01.

The Koelbel reactor is a three-phase Fischer-Tropsch reactor in which synthesis gas is passed upward through a slurry of finely divided catalyst in a heavy oil medium and products are removed overhead. Koelbel claimed that this reactor configuration allowed the processing of synthesis gas with low H_2:CO ratios at high single-pass conversion with excellent temperature control and without the rapid aging because of carbon deposition normally encountered with such feeds in other reactor types. These reactor characteristics might thus allow conversion of the low H_2:CO ratio output from second-generation coal gasifiers directly without preliminary water-gas shifting and without extensive recycle. Such operation should result in improved thermal efficiency and decreased processing costs. However, the product distribution reported was relatively conventional for Fischer-Tropsch performance so that the need for octane improvement for gasoline production would still exist. The Mobil-Gasoline process converts methanol to high-octane gasoline in high efficiency. There are recent indications that the shape-selective zeolite catalyst used might also accept crude Fischer-Tropsch products as a feed instead of methanol. Conceptual combination of all these observations leads to an advanced indirect liquefaction scheme for coal consisting of a second-generation gasifier coupled to a slurry Fischer-Tropsch reactor coupled to a Mobil-Gasoline upgrading unit. This concept is developed further, but it is noted that other investigators have had some difficulty in repeating Koelbel's very favorable results.

12963 (ORO—3054-T3) **SRC-I coal refinery. Tasks 1 and 2. Preliminary demonstration plant design and cost estimates and long lead procurement planning: summary.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 514p. Dep. NTIS, PC A22/MF A01.

Is it technologically and economically feasible to refine raw coal of high sulfur content into an environmentally acceptable solid product that will reduce the nation's dependence on imported oil. The short answer is yes. The longer answer is given in this volume and the 14 other volumes which complete Phase 0 of a four-phase project to design, construct, operate, and evaluate the first module of a multimodule commercial plant. This first module will be a demonstration plant with the capacity to refine 6000 tons per day (TPD) of raw coal. The full commercial plant will consist of five such modules. Phase 0 has required the contractors to conduct an extensive study of the Solid Solvent Refined Coal (SRC-I) process and to provide preliminary design and cost estimates for the demonstration plant. The work has included preparing basic process descriptions and specifications, process flow and control diagrams, heat and material balances, mechanical and other detailed specifications for the critical equipment (defined as complex items requiring special fabrication that affect the overall design), single line electrical diagrams, utility summaries, waste stream lists, plot plans, a plant model, a process hazards reveiw, operational studies, and a technical risk assessment. Special attention has been paid to examining the process trade-offs and the technical uncertainties, to evaluating the design data base, and to identifying areas where additional data is needed. The full range of the potential impact of the SRC-I process on the environment has been investigated and a preliminary selection of the best available technology for mitigating any adverse effects has been made.

12964 (ORO—3054-T3(App.A)) **SRC-I coal refinery. Task 1, Appendix A. SRC process plant: filtration deashing.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 792p. Dep. NTIS, PC A99/MF A01.

Under subcontract to Air Products and Chemicals, Inc. (APCI), Catalytic, Inc. (Catalytic) had the responsibility during this Phase Zero effort to carry out a preliminary process study and cost estimate for the 6000 TPD SRC-I Demonstration Plant. Catalytic's involvement was limited to two areas, as follows: Area 12 - SRC Process; and Area 13 - Deashing. In this study, SRC Deashing is

accomplished by Filtration. A secondary study, in which the SRC Deashing is accomplished via the Kerr-McGee Critical Solvent Process, is presented in a separate report. Catalytic's scope in these areas included generating heat and material balances, developing process and control flow diagrams, sizing equipment, estimating utilities requirements, and preparing estimates of costs and schedule for completion through Phases I and II of the demonstration plant program. All of this information is presented to demonstrate the technical feasibility of producing solid SRC.

12965 (ORO—3054-T3(App.B)) **SRC-I coal refinery. Task 1, Appendix B. Gas systems plants.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 736p. Dep. NTIS, PC A99/MF A01.

The Ralph M. Parsons Company was commissioned by Air Products and Chemicals, Inc. to perform the initial phase study consisting of the evaluation of various commercial process techniques and to develop an economical and viable processing concept with respect to the Gasification, Gas Treating, Compression, and Sulfur Recovery Areas for the 6000-TPd SRC-I Demonstration Plant that is to be built near Newman, Kentucky. This report has been prepared to facilitate a comprehensive review of the facilities as well as responding to the specific sub-tasks as established for this study. There are four areas which constitute the SRC-1 Demonstration Plant Gas System: Area 15 - Gasification; Area 16 - Gas Treating, DEA Unit, Selexol Unit, and Ammonia-Sulfide Stripping Unit; Area 17 - Compression; and Area 18 - Sulfur Recovery, Claus Unit, and Beavon Sulfur Removal Unit. A complete description of each area and/or unit is included in accordance with the following: process design, process waste stream list, mechanical equipment specifications, operational studies, process hazards review, schedule for Phases I and II, capital investment summary, and plot plans and model photographs.

12966 (ORO—3054-T3(App.C)) **SRC-I coal refinery. Task 1, Appendix C. Air separation and hydrogen recovery plants.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 221p. Dep. NTIS, PC A10/MF A01.

Air separation plants (to produce oxygen) and the hydrogen recovery system related to the SRC process demonstration plant are described: design, equipment, specifications, waste streams, hazards, capital investment, etc. (LTN)

12967 (ORO—3054-T3(App.D)) **SRC-I coal refinery. Task 1, Appendix D. Coker-calciner plant.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 275p. Dep. NTIS, PC A12/MF A01.

The Lummus Company has been engaged to conduct an engineering study of the coker/calciner system to be incorporated in the proposed SRC-I demonstration plant. Lummus's assignment during Phase 0 is to prepare a preliminary process design and a cost estimate for the coker/calciner system. The Delayed Coker/Calciner Plant will produce anode grade coke from deashed Solvent Refined Coal (SRC-I). Byproducts of this plant will include a light oil stream with 378°F ASTM end point and a heavy oil stream with an Initial Boiling Point (IBP) of 373°F. The description of the process can readily be followed by referring to the Process and Control Diagrams, and the simplified flow scheme. The Lummus delayed coking process was selected because of the extensive experience of Lummus over many years in designing both petroleum residue cokers and coal tar pitch coking units. The design and operation of coal tar pitch coking units are particularly relevant to the process and mechanical requirements of a delayed coker fed with solvent refined coal (SRC-I) in the liquid state.

12968 (ORO—3054-T3(App.E)) **SRC-I coal refinery. Task 1, Appendix E. Utilities and off-sites.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 474p. Dep. NTIS, PC A20/MF A01.

This Preliminary Design Report presents the preliminary technical data and the capital investment summary for the Utilities and Offsites portion of the 6000 TPD SRC plant. Utilities includes electric power and water supplies and lines in the plant, coal receiving and preparation (including materials handling), waste streams, hazards, equipment specifications and process control equipment. Information on which the design of the above depends is described. Process description, P and CD's, design basis, process trade-off and technical uncertainty studies, heat and material balances, process specifications, utility summary, electrical single line diagrams, and the utility distribution diagrams. (LTN)

12969 (ORO—3054-T3(App.F)) **SRC-I coal refinery. Task 1, Appendix F. Kerr-McGee critical solvent deashing.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 492p. Dep. NTIS, PC A21/MF A01.

The objective of this program is to design, construct, operate, and evaluate a 6000 TPD SRC-I Demonstration Plant as the first module of a 30,000 TPD commercial scale plant. Under subcontract to Air Products and Chemicals, Inc. (APCI); Catalytic, Inc. (Catalytic) had the responsibility to carry out a preliminary process study and cost estimate for the 6000 TPD SRC-I Demonstration Plant. Catalytic's involvement was limited to two areas, as follows: Area 12 - SRC process, and Area 13 - Deashing. In this Appendix, SRC deashing is accomplished by the Kerr-McGee Critical Solvent Deashing (CSD) Process. The onsite design for the Kerr-McGee CSD Process was prepared by Catalytic, Inc. Catalytic's scope in these areas included generating heat and material balances, developing process and control flow diagrams, sizing equipment, estimating utilities requirements, and preparing estimates of costs for Phases I and II of the demonstration plant program. All of this information is presented in Sections II through VIII. The design changes necessary to generate hydrogen from ash concentrate produced by the Kerr-McGee CSD Process are documented. The changes required in utilities and offsites for the Kerr-McGee CSD Process are provided in Section X.

12970 (ORO—3054-T3(App.G)) **SRC-I coal refinery. Task 1, Appendix G. General construction specifications.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 404p. Dep. NTIS, PC A18/MF A01.

This volume contains engineering specifications which define materials and workmanship for bulk commodities of construction work.

12971 (ORO—3054-T4(Pt.A)) **SRC-I coal refinery. Task 3A. Market analysis.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 264p. Dep. NTIS, PC A12/MF A01.

With nuclear power plagued by uncertainty, coal may have to carry an even larger burden for electricity generation and other forms of energy than the tripling of use already contemplated. To achieve the necessary expansion, most uses of coal will have to meet stringent environmental standards. Under the New Source Performance Standards (NSPS) published in June 1979, most coals, regardless of sulfur content, will require air pollution control when burned. Pre-cleaning technologies such as SRC-I have a simple but fundamental advantage over other methods. Since the fuel already has been cleaned, there is no need for elaborate combustion or post-combustion cleaning technologies that can force shutdowns of the entire utility generating plant for repair or maintenance of the pollution control equipment. In addition, because SRC products are clean burning, undesirable slagging and ash are minimized which further improves boiler availability. Extensive burn tests including a commercial-scale test have shown that SRC qualifies as a compliance fuel for new boilers under the revised NSPS, not only for sulfur dioxide, but for nitrogen oxide, and, with the use of appropriate cntrol equipment, for particulates. SRC also complies with the emission standards for the retrofit of old boilers and other combusters. In combination with SRC, TSL makes possible a high output of liquids that, taken together, are essentially the equivalent of conventional crude oil. This synthetic crude can be upgraded and refined into essentially all of the end-use products distilled from conventional crude oil, although some products, such as gasoline, would be more economical than others such as diesel and jet fuels. In addition, SRC is well suited for entry into the carbon products market.

12972 (ORO—3054-T6) **SRC-I coal refinery. Task 5. Definitization plan for Phases I, II, and III.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 267p. Dep. NTIS, PC A12/MF A01.

A definitive plan has been prepared for the design, procurement, construction, and operation of an SRC-I Coal Refinery for processing approximately 6000 TPD of Kentucky No. 9 coal to produce products which can displace oil. The plan contemplates locating the plant, costing approximately $500 million, at a site near Newman in Daviess County, Kentucky with initial operation of the facility in January 1984. It recommends that the plant include a second stage of liquefaction (LC-Fining) for processing a portion of the product SRC into fuel oil or feedstock for gasoline and/or petrochemicals. The site was selected via a meticulous procedure of elimination by the Rust Engineering Company under contract to the Kentucky Center for Energy Research. The site is accessible by highway, railroad, and river barge, and is located in a coal belt so that the coal supply finally selected should be within 55 miles of the site. The Phase 0 technical studies indicate that viable alternatives are available for all of the processing steps required. Final decisions must be made early in Phase 1 on (1) the method for solids separation, (2) the type of gasifier to be used for generating hydrogen, and (3) the design capacity to be included for further processing of product SRC to coke by coking/calcining and for a second liquefaction stage to convert product SRC to liquid fuels. The final decisions will be based on up-to-date information from the pilot plants along with strategic marketing, legal, and economic considerations.

12973 (ORO—3054-T7) **SRC-I coal refinery. Task 7. Environmental analysis.** (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 353p. Dep. NTIS, PC A16/MF A01.

Task Seven - Environmental Analysis contains a discussion of all the environmental issues related to the construction and operation of the 6,000 TPD SRC-I Demonstration Plant. The SRC-I process will generate a number of air emissions including sulfur dioxide, particulate, hydrocarbons and reduced sulfur compounds. The major impact on the environment is expected to be caused by sulfur dioxide and hydrocarbon emissions. Sulfur dioxide emissions have been greatly reduced by utilizing the clean fuel gas generated by the SRC-I plant as a fuel source. Hydrocarbon emissions have been greatly reduced by employing control techniques. Wastewater generated in several areas of the SRC-I plant will be collected and treated by a treatment facility located on the plant site. Solid waste generated by the SRC-I process will be handled as follows: inert mineral ash residue will be stored on-site in accordance with best engineering practice; hazardous wastes will be disposed of in a permitted secure landfill located on-site; and non-hazardous waste will be recycled to the process for ultimate degradation. Compliance with applicable environmental regulations influences the design of the plant. To insure that the plant will be in compliance, all directly applicable regulations were combined with the most stringent regulations which could be determined for similar facilities and complied to provide a set of effluent guidelines. Specific compliance techniques are discussed in this volume. An environmental analysis is being carried out to provide the basis for preparation of an Environmental Impact Statement.

12974 Catalyst withdrawal and addition in a coal liquefaction process. Simone, A.A.; Ogren, D.F. (to The Lummus Co.). US Patent 4,172,024. 23 Oct 1979. Filed date 15 Jun 1978. 6p.

The catalyst is withdrawn from a coal hydroliquefaction reactor while it is maintained on stream by withdrawing a portion of the catalyst, in a separate stream, dispersed in product from the liquefaction zone, with such withdrawn stream being further diluted with liquid recovered from the main product stream to reduce the catalyst concentration. The catalyst containing stream is introduced into the ash separation zone, wherein catalyst is recovered with the ash containing solids. Fresh catalyst is subsequently added to the liquefaction zone in a stream of the liquid recovered from the main product stream.

12975 Structural difference between petroleum and coal-derived asphaltenes. Yen, T.F. (Univ. of Southern California, Los Angeles). *Am. Chem. Soc., Div. Pet. Chem., Prepr.;* **24**: No. 4, 901-909(Sep 1979). (CONF-790917—(Vol.24)(No.4)).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

A very distinctive feature of coal-derived asphaltenes is that they appear to be associated both in concentrated and diluted solutions, and, particularly, in nonpolar solvents. This fact is supported by the viscosity measurement. The hydrogen-bonding nature of the interaction within the coal-derived asphaltenes is important. The weak linkage in coal and coal-derived products may be due to the excessive inter- and intra-molecular bonding. The fact that the solubilization and swelling curves are similar is important. This type of bonding may increase its extent of crosslink so much that carboid (or preasphaltene) is no longer benzene-soluble. There has been limited work on the long-range order of coal-derived asphaltene. The aromaticity of petroleum-derived asphaltene (f/sub a/ = 0.2 to 0.5) is lower than that of coal-derived asphaltene (f/sub a/ = 0.6 to 0.7). The aromatic ring systems within petroleum-derived asphaltene are much more condensed than that of coal-derived asphaltene. The substituents of the petroleum-derived asphaltenes are longer (n = 4 - 6) than those of coal-derived asphaltenes (n = 1). The aromatic system of petroleum-derived asphaltene is extensively substituted (70 to 80%), whereas the coal-derived asphaltene is sparingly substituted (35 to 45%). The molecular weight of petroleum-derived asphaltene is ca. 10 times higher than that of the coal-derived asphaltene. Petroleum-derived asphaltene is less reactive to physical or chemical agents than that of coal-derived asphaltene. Petroleum-derived asphaltene is more highly associated (Me = 5 - 7) than that of coal-derived asphaltene (Me = 2 - 4). This will be reflected in the ease of processing. Petroleum-derived asphaltene is less polar than the coal-derived asphaltene.

12976 Structural characterization of coal-derived asphaltenes and its significance to liquefaction. Bockrath, B.C.; Schweighardt, F.K. (Pittsburgh Energy Tech. Center, PA). *Am. Chem. Soc., Div. Pet. Chem., Prepr.;* **24**: No. 4, 949-954(Sep 1979). (CONF-790917—(Vol.24)(No.4)).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Comparisons between asphaltenes derived from bituminous coal liquefaction and those derived from petroleum crudes are summarized. It is evident that the molecular size and atomic H/C ratios suggest a molecular profile quite different for the two asphaltenes. Benzene solubility of petroleum asphaltenes is apparently due to the structural arrangement of the long aliphatic sidechains on aromatic rings. Coal-derived asphaltenes are benzene soluble due to their smaller size-lower molecular weight and the greater concentration of functional groups. The nature of the functional groups also appears to be different, e.g., oxygen appears as hydroxyl and ether moieties in coal-derived asphaltenes, while petroleum asphaltenes contain hydroxyl, carbonyl and some ether linkages. Nitrogen, as well as oxygen, has only two predominant forms in coal asphaltenes, NH and base nitrogen -N=, while petroleum contains, in addition to those groups NH_2 functions. Liquefaction processing conditions greatly influence the properties of coal-derived asphaltenes. It is difficult to make generalizations from the limited and widely scattered data available, but we may point out the results of our recent study of asphaltene character as a function of processing history. In this study, a liquid product containing 31.7 percent asphaltenes was hydrotreated in a stirred autoclave under a variety of conditions, both with and without a CoMo catalyst, so that various amounts of conversion to pentane soluble oils were obtained. It was found that the asphaltenes remaining after hydrotreatment were more aromatic, contained fewer polar functional groups, and were of somewhat smaller average molecular size than those present before hydrotreating. The chemical character of the unconverted asphaltenes is also a function of processing. Both the H/C and O/C atomic ratios declined in a regular manner as conversion progressed.

12977 Composition of asphaltenes from coal liquids. Aczel, T.; Williams, R.B.; Chamberlain, N.F.; Lumpkin, H.E. (Exxon Research and Engineering Co., Baytown, TX). *Am. Chem. Soc., Div. Pet. Chem., Prepr.;* **24**: No. 4, 955-962(Sep 1979). (CONF-790917—(Vol.24)(No.4)).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Asphaltenes are generally defined as those components in petroleum and coal liquids that under certain conditions are soluble in benzene but insoluble in aliphatic solvents, such as n-pentane, n-heptane or cyclohexane. This definition obviously includes a broad variety of components, as insolubility in the above solvents can be caused by high molecular weight, high polarity, hydrogen bonding, acid-base complexing or a combination of two or more of these parameters. Asphaltenes are thought to be a major intermediate in the thermal processes leading to coal liquefaction. Coal derived asphaltenes are generally more polar but of lower molecular weights than petroleum asphaltenes, and, thus, are more amenable to detailed compositional analyses. We have recently determined the structural parameters and composition of some asphaltene samples obtained from the Synthoil and Exxon Donor Solvent (EDS) liquefaction processes. Information from many spectrometry, integrated with data from NMR, IR, molecular weight determinations, elemental analysis and separations furnished us with a novel and detailed insight into the nature of these asphaltenes. The excellent agreement observed between composites calculated from the detailed MS data, where available, and the averages determined by NMR, IR, elemental analyses, etc., reinforces the credibility of the approaches used and allows extrapolations to heavier samples that are not amenable to detailed MS characterization. This paper describes briefly the analytical methodology used, summarizes the more than 1200 individual asphaltene components determined, and discusses the overall structural implications of the integrated analytical findings.

12978 Consequences of the mass spectrometric and infrared analysis of oils and asphaltenes for the chemistry of coal liquefaction. Scheppele, S.E. (Oklahoma State Univ., Stillwater); Benson, P.A.; Greenwood, G.J.; Grindstaff, Q.; Aczel, T.; Bieber, B. *Am. Chem. Soc., Div. Pet. Chem., Prepr.;* **24**: No. 4, 963-973(Sep 1979). (CONF-790917—(Vol.24)(No.4)).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Our results demonstrate that the use of the yields of the oils and asphaltenes obtained by simple solvent extraction to deduce the effect of (a) variation in reaction conditions and catalyst on the mechanism and kinetics of coal liquefaction and (b) alteration in process conditions on the quality of the coal liquid lead to erroneous conclusions unless the yields are corrected for overlapping distributions. Consequently, detailed molecular analysis of solubility fractions is an essential requirement for indepth study of the chemistry of coal liquefaction and for correct evaluation of process effectiveness. Alternatively, the fractions obtained by simple solvent extraction could be subjected to detailed fractionation.

12979 (ORO—3054-T4(Pt.3B)) SRC-I coal refinery. Task 3B. Economic assessment. (Southern Co. Services, Inc., Birmingham, AL (USA)). 31 Jul 1979. Contract ET-78-C-05-3054. 91p. Dep. NTIS, PC A05/MF A01.

An important part of the Phase 0 analysis has been to review the possibilities for developing a commercial market for the products of the SRC plant. One stage of this analysis was to develop the capital and operating costs of a new 30,000 TPD SRC Plant to be built in the 1983-1987 time period, and operated in the 1988-2007 time period. The capital and operating costs developed for this plant were in 4th quarter 1978 dollars, and were based on the assumption that this would be the Nth Plant - a plant built as part of an existing industry; after other plants were built and the technology was

proven on a large scale. In order to better understand the economic impact of these costs, a sensitivity analysis was performed on the costs, which were restated into current dollars as of the year expended. In addition to the analysis required by DOE, the JV also carried out several additional analyses to illustrate the effect of assumptions which it felt were more realistic. The conclusion of these analyses is that SRC could be manufactured for $5.00 to 6.50 per MM Btu in 1988 in an Nth Plant costing approximately $2.3 billion in current dollars based on a 6% inflation rate. The 1988 price of $5.00 to 6.50 per MMBTS is equivalent to a 1978 price of $2.80 to $3.65 per MMBTU, deflated at 6% per annum. Thereafter, assuming a 6% annual inflation rate in coal and other operating costs, the cost of SRC would increase at 4.3% per year over a 20-year period. Thus, on a levelized basis, the cost of the SRC would be below the $2.80 to $3.65 range (1978 $'s).

12980 Producing fluid fuel from coal. Doehlert, D.H. (to Fluid Coal Corp.). US Patent 4,159,897. 3 Jul 1979. Filed date 13 Oct 1977. 8p.

In a coal liquefaction system, product B.T.U./hr can be significantly increased by dividing the coal to be treated into two portions, liquefying one portion, and adding the other portion to the product of the liquefaction process to produce a suspension for use as a fuel. The process is carried out by adding conventionally available equipment to a coal liquefaction plant, and the total plant is far less expensive to build and operate than a conventional liquefaction plant having the same production in terms of product B.T.U./hr.

12981 Chemistry of asphaltenes. Selective oxidation and aromatic chemistry. Government role in fuels research and development. Symposium overview. Washington, DC; American Chemical Society (1979). 212p. (CONF-790917—(Vol.24)(No.4)). Phillips Petroleum Co., Bartlesville, OK.

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

The fall meeting of the Division of Petroleum Chemistry, Inc. of the American Chemical Society was held in Washington, DC, September 9-14, 1979. Two symposia were Chemistry of Asphaltenes and Selective Oxidation and Aromatic Chemistry; only 15 individual papers of the former were entered individually into EDB and ERA. The papers discuss isolation of the asphaltenes, their molecular weight, their viscosity and their chemical nature (condensed aromatics). Asphaltenes separated from coal liquids have markedly lower molecular weight than those separated from petroleums. (LTN)

12982 Coal liquefaction apparatus. Sinor, J.E.; Gray, J.A.; Oberg, C.L. (to Rockwell International Corp.). US Patent 4,169,128. 25 Sep 1975. Filed date 24 Feb 1977. 12p.

Disclosure is made of an apparatus for reacting carbonaceous material with heated hydrogen to form hydrocarbon gases and liquids suitable for conversion to fuels wherein the reaction involves injection of carbonaceous material such as pulverized coal entrained in a minimum amount of gas and mixing the entrained coal at near ambient temperature with a separate source of heated hydrogen. The hydrogen is heated in a coil having an increasing inside diameter. The heated hydrogen and entrained coal are injected through a rocket engine type injector device. The coal particles are reacted with hydrogen in a reaction chamber downstream of the injector. The products of reaction are rapidly quenched as they exit the reaction chamber and are subsequently collected.

PYROLYSIS AND CRACKING

12983 (FE-MIT—2295T26-9) **Critical studies of the rapid pyrolysis and hydropyrolysis of coal. Quarterly progress report, February 10, 1979-June 30, 1979.** Howard, J.B.; Bigot, P.C.; Bush, T.W.; Caron, R.; Casaprima, R.; Franklin, H.; Serio, M.A.; Steinberg, R.M.; Zacharias, M.; Peters, W.A. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1979. Contract EX-76-A-01-2295-026. 5p. Dep. NTIS, PC A02/MF A01.

Preparation of coal samples pretreated with minerals was completed in this period. Samples of demineralized coal were impregnated with CaO from solution, or co-slurried with suspensions of quartz, pyrite, kaolinite, shale, montmorillonite, or acid-treated montmorillonite. These, along with the calcite and $FeSO_4$ pretreated coals prepared earlier form the complete suite of treated samples of the Pittsburgh Seam bituminous coal to be investigated in this program. The remainder of the reporting period was spent obtaining pyrolysis data. Runs were performed on demineralized bituminous coals under 1000 psi H_2 which, on completion, will give base case curves similar to those previously obtained under 1 atm He. Pyrolysis of the calcite and CaO pretreated samples was carried out at 1 atm He, under the test conditions of 700°C zero holding time, and 1000°C, 5 second holding time. While complete calculations have not yet been completed, a definite mineral matter effect was noted in both cases. Tar production was suppressed, light gas yield and ethylene/ethane ratio increased slightly, and there was a multi-fold increase in production of carbon oxides, CO_2 at lower temperatures, shifting to CO at higher temperatures. This effect was more pronounced with the $CaCO_3$ sample than with the CaO sample, the excess carbon oxides in the former case probably originating from calcite decomposition. These results have interesting implications for the modelling of coal pyrolysis, and further study of these minerals will probably be undertaken after test case analysis of the remaining mineral treated samples is completed.

BY-PRODUCTS

12984 (FE—1207-T14) **Gas generator research and development BI-6AS process. Use of Calcilox as a solidification agent in the settling pond.** (Bituminous Coal Research, Inc., Monroeville, PA (USA); Phillips Petroleum Co., Homer City, PA (USA)). Oct 1979. Contract EF-77-C-01-1207. 19p. Dep. NTIS, PC A02/MF A01.

Since initial operations began in August 1976 the handling and disposal of fine solids from the BI-GAS Pilot Plant waste disposal pond has been a problem. The fines produced in the coal grinding operation as well as carry over from the coal and char cyclones have particularly aggravated that problem. The contract with the Indiana Borough Sewage Plant limits the amount of solids, in slurry form, it receives to 520 lbs/day. Therefore, coagulants have been used to separate the suspended fines from the wastewater. Periodically, the pond must be emptied as a result of this practice. An effective means of solids disposal is necessary for extended operation of the BI-GAS Pilot Plant and may be necessary for a commerical design. This report presents the results of a laboratory study evaluating the applicability of using Calcilox to stabilize the soupy consistency of the wastewater pond. Calcilox is a calcuim-based chemical, developed by Dravo Corp., that triggers cementatious type reactions entrapping the refuse particles and water in a consolidated soil-like consistency. The results of the testing program substantiates Dravo's claim; however, the amounts of the solid necessary to do the job were considered excessive. The tests evaluated a 20% and a 35% by weight slurry concentration of fines to which Calcilox, in concentrations up to 50% by weight of the fines, was added. Because the process was enhanced in an alkaline environment, lime concentrations up to 3% by weight of the fines, was also added in certain tests. From an evaluation of the data, it is expected that 30 to 50% Calcilox and 2 to 3% lime addition (by weight of the solids contained), would be necessary to effect reasonable stabilization of an initial 35% slurry. Somewhat greater amounts would be necessary at lower slurry concentrations.

12985 Liquid and gaseous fossil energy resources of the Illinois and Appalachian Basins. Pasini, J. III. (Morgantown Energy Research Center, WV). pp 11-13 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

This paper reviews available data concerning Appalachian and Illinois Basin liquid and gaseous hydrocarbon resources and, where applicable, the economically recoverable oil and gas reserves. Included are resources for conventional oil and gas reservoirs, gas from shales and coalbeds and associated strata, and oil from shales and tar sands. Of the total liquid and gaseous hydrocarbon resources, ranging from 200 to 5,000 quadrillion Btu's, approximately 10 to 15 quads are in the proven economically recoverable category. This paper does not deal with projections concerning yearly production of liquid and gaseous hydrocarbons, because such projections depend on factors far beyond the technology advances and the applicable economics of moving resources to the proven economically recoverable reserves category.

PROPERTIES

REFER ALSO TO CITATION(S) 12932, 12960, 12975

12986 (EPRI-FP—989(Vol.5)) **Nuclear assay of coal. Volume 5. Coal Btu measurement study: monitoring of moisture in coal. Final report.** Brown, D.R. (Science Applications, Inc., Palo Alto, CA (USA)). Sep 1979. 79p. Dep. NTIS, PC A05/MF A01.

Two electromagnetic techniques, capacitance response and microwave absorption, have been investigated for on-line moisture monitoring of coal. The response of instruments based on these techniques was measured using a representative range of US coal types ad moisture levels. Uncertainties in moisture determinatio of less than 5% were obtained with both techniques. However, a microwave interrogation is judged best for on-line application because it is both accurate and nonobtrusive. In on-line applications, this level of accuracy in moisture determination, combined with

reasonable accuracies in determination of the elemental content, will allow the Btu value of the coal to be deduced to accuracies of 2% or better.

12987 Economics of coal preparation and portable plants. Cox, R.B. (Univ. of Tennessee, Chattanooga). pp 57-65 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

This study explores published data on washability characteristics of coal in the Appalachian and Alabama Regions and attempts to point out methods of evaluating economic factors important for assessing the use of coal-washing plants. Typically, many of the raw coals from the areas investigated contain an average of 12.0% ash, 2.0% pyritic sulfur, and 3.0% total sulfur. Various tests have shown that 60% to nearly 100% of the pyritic sulfur can be removed by conventional mechanical washing of coals. The likelihood of strict enforcement of environmental standards, which now call for no more than 1.2 lb of SO_2 emission per million Btu, demand careful review of all methods that can assist in providing coal which can be burned in compliance with the standards. A brief review of portable washing plants is also included in the study.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 13036, 13524, 13525, 13526, 14050, 14182, 14193, 14194, 14195

12988 (CANMET—78-31) **Coal associated materials as potential nonbauxite sources of alumina.** Winer, A.; Tibbetts, T.E. (Department of Energy, Mines and Resources, Ottawa, Ontario (Canada). Canada Centre for Mineral and Energy Technology). Oct 1978. 19p. Canada Centre for Mineral and Energy Technology, Ottawa, Ontario.

Coal mine and wash plant rejects from southern Alberta and British Columbia represent a potential source of alumina. The Hat Creek area of British Columbia represents the best potential source of coal-associated alumina both quantitatively and qualitatively. Alumina contents of up to 32% of the ash have been determined in samples from this area. Fly ash from pulverized coal-fired power generating plants in Alberta and possibly from Hat Creek, British Columbia, and in Ontario also represent potential sources of alumina-containing material. Exploratory drilling will be required to evaluate coal-associated shales in Alberta and Saskatchewan. 13 refs.

12989 (FE—1817-6) **Pollutant control through staged combustion of pulverized coal. Final report, May-October, 1978.** Wendt, J.O.L.; Glass, J.W. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). May 1979. Contract EX-76-C-01-1817. 161p. Dep. NTIS, PC A08/MF A01.

Pulverized fuel was burned in a 2 kg/hr aerodynamically well-defined plane flame combustor, and the resulting time resolved profiles of CO_2, CO, O_2 and NO were measured. In this final report on Contract E 49-18-1817 the influence of pulverized fuel composition on NO formation mechanisms is emphasized, with particular stress on the role of coal volatile content. The latter quantity was varied by burning first an FMC char with 3.6% Volatile Matter, then an IGT char with 13.6% Volatile Matter and lastly a series of various coals comprising a lignite, a subbituminous coal, and three bituminous coals. These fuels were investigated under fuel rich and staged combustion conditions. Under staged combustion, second stage NO was found to be strongly influenced by the amount of first stage volatile nitrogen carryover. The latter quantity depended on the first stage fuel richness and on the amount of volatiles in the coal. Under fuel rich conditions the NO profile was controlled by the fuel nitrogen volatility relative to the volatility of the non-nitrogeneous combustibles in the coal. A series of tests on one coal showed that the observed decay of NO in the first fuel rich stage could be simply correlated with temperature. This latter result implies that a high heat removal rate in the first stage of a staged combustion process will lead to minimum NO emissions after staging.

12990 (FE—3199-X1) **Electron beam ionization for coal fly ash precipitators. Extended report No. 1, July 14, 1978-June 13, 1979.** Davis, R.H. (Florida State Univ., Tallahassee (USA)). Jul 1979. Contract ET-78-S-01-3199. 26p. Dep. NTIS, PC A03/MF A01.

Earlier experiments using electron beam ionization in electrostatic precipitators were extended using a new laboratory scale test system and larger power supplies. An approximately ohmic relationship between ion current and plate voltage suggests the formation of a large grounded plasma region between the electrodes. Large current densities, as high as 500 times that of conventional precipitators, have been observed with no saturation. Variations in ion current densities with beam energy, current, and collimation are due to the intensity of beam ionization in the interelectrode space. Sparkover voltage is probably determined by beam geometry which controls the plasma-to-electrode gap distance and the width of the ionization zone. Measurements with good geometry are required to observe saturation and investigate the interplay between ionization zone restriction and sparkover. Future work will include the use of a medium which simulates fly ash and will address the phenomenon of back corona and its effect on sparkover.

12991 (PB—290946) **Air emissions from combustion of solvent refined coal. Final report, March 1977—September 1978.** Budden, K.G.; Patel, S.S. (Hittman Associates, Inc., Columbia, MD (USA)). Jan 1979. Contract EPA-68-02-2162. 48p. NTIS, PC A03/MF A01.

The report gives details of a Solvent Refined Coal (SRC) combustion test at Georgia Power Company's Plant Mitchell, March, May, and June 1977. Flue gas samples were collected for modified EPA Level 1 analysis; analytical results are reported. Air emissions from the combustion of coal and SRC are compared for various organic and inorganic constituents, and SO2 and NOx. The impact of the air emissions from the combustion of SRC is assessed by comparison with EPA's Multimedia Environmental Goals and existing New Source Performance Standards. Air quality emissions test data indicated that SRC SO2 and NOx emissions were 1.06 and 0.43 lb/million Btu, respectively; or about 12 and 39% under the existing NSPS of 1.2 lb/million Btu for SOx and 0.7 lb/million Btu for NOx. If the SO2 standard is reduced, SRC derived from high sulfur coal may not meet the new standard. The low NOx emissions may be a result of the abnormally high excess air that was used during the test: additional testing at normal conditions is required. Particulate emissions can probably be controlled well below the EPA standard of 0.1 lb/million Btu by installing a modern ESP, with a particulate collection efficiency of about 95%.

12992 (PB—294876) **Amendment properties of ammonium sulfate and ammonium nitrate and their combinations with gypsum and SO2 scrubber waste. Final report, April 1975-1979.** Skaptason, J.B.; Skaptason, J.A. (Biosearch and Development Co., Inc., Kansas City, MO (USA)). May 1977. Contract OWRC-10570110. 392p. NTIS PC A17/MF A01.

The results obtained from this study provide guidelines for determining the potential of waste gypsum from sulfur scrubbing operations as an agricultural soil amendment in the reclamation of sodic soils. Included in the study were (1) a survey of the literature; (2) physical collection of gypsum waste, sodic soils and spoil pile samples, (3) chemical analyses; (4) greenhouse plant growth trials and (5) field trials.

12993 (PB—295001) **Flue gas desulfurization pilot study, phase i. survey of major installations, report no. 95, summary of survey reports on flue gas desulfurization processes.** Princiotta, F. (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 35p. NTIS PC A03/MF A01.

Appendices to this summary consist of twelve individual status reports that will be available through the National Technical Information Service (NTIS) in the United States and of course limited copies will be available through NATO. The twelve report titles which are appendices to the summary are: (A) Status Report on the Limestone/Sludge Flue Gas Desulfurization Process; (B) Status Report on the Lime/Sludge Flue Gas Desulfurization Process; (C) Status Report on the Double Alkali/Sludge Flue Gas Desulfurization Process; (D) Status Report on the Sea Water Scrubbing Flue Gas Desulfurization Process; (E) Status Report on the Limestone/Gypsum Flue Gas Desulfurization Process; (F) Status Report on the Lime/Gypsum Flue Gas Desulfurization Process; (G) Status Report on the Double Alkali/Gypsum Flue Gas Desulfurization Process; (H) Status Report on Flue Gas Desulfurization by Scrubbing with Dilute Sulfuric Acid; (I) Status Report on the Magnesium Oxide Flue Gas Desulfurization; (J) Status Report on the Sodium Sulfite Scrubbing Flue Gas Desulfurization Process; (K) Status Report on the Carbon-Adsorption Flue Gas Desulfurization Process; (L) Status Report on the Copper Oxide Flue Gas Desulfurization.

12994 (PB—295005) **Flue gas desulfurization process, study, phase I. Survey of major installations. Appendix 95-d, Sea water scrubbing flue gas desulfurization process.** Hagen, R.I.; Kolderu, H. (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 65p. NTIS PC A04/MF A01.

An assessment study of the sea water scrubbing process for flue gas desulfurization has been made by SINTEF. This project has been financially supported by the Royal Ministry of Environment of Norway. The study is based on three FGD-units which are installed at three oil-fired, industrial boilers respectively with a maximum continuous heat input of 130 MW (27 MW + 2x51.5 MW) corresponding to approximately 50 MWE (10 MWE + 2x20 MWE) generating capacity for a power plant having a net efficiency of 38%.

12995 (PB—295008) **Flue gas desulfurization pilot study. phase I. Survey of major installations. Appendix 95-g. Double alkali/gypsum flue gas desulfurization process.** Princiotta, F.; Gerstle, R.W.; Schindler, E. (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 79p. NTIS PC A05/MF A01.

The double alkali/gupsum method of flue gas desulfurization (FGD) was developed to reduce scaling and plugging problems associated with direct lime (CaO) or limestone ($CaCO_3$) systems. One of the first large-scale installations of this process to control SO_2 emissions and produce gypsum ($CaSO_4$) was put in operation in 1973 at the Showa Denko plant in Chiba, Japan. By December 1977, 25 systems were operating, all in Japan. The double alkali system is especially applicable in situations requiring high (98 percent) SO_2 removal, high availability, and low maintenance. The process is particularly applicable to areas where lime/limestone resources are abundant and where gypsum is a marketable by-product. If it is not marketable, gypsum and fly ash can be used as landfill to form a base with load-bearing capacities sufficient for some construction.

12996 (PB—295009) **Flue gas desulfurization pilot study. phase I. Survey of major installations. Appendix 95h. Flue gas desulfurization by scrubbing with dilute sulfuric acid.** Princiotta, F.; Gerstle, R.W.; Schindler, E. (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 63p. NTIS PC A04/MF A01.

The Chiyoda Thoroughbred 101 (CT-101) process, the only flue gas desulfurization (FGD) system on the market using sulfuric acid scrubbing, is gaining popularity. Fourteen systems are in operation in Japan, ranging in capacity from 30 MW to 350 MW.

12997 (PB—295010) **Flue gas desulfurization pilot study. phase I. Survey of major installations. Appendix 95-i. Magnesium oxide flue gas desulfurization process.** Princiotta, F.; Gerstle, R.W.; Schindler, E. (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 87p. NTIS PC A05/MF A01.

Magnesium oxide flue gas desulfurization (FGD) is a regenerable process. The sulfur dioxide (SO_2) in the flue gas is absorbed by a magnesium-based slurry, and the resulting magnesium sulfite ($MgSO_3$) is calcined to regenerate magnesium oxide (MgO), which is recycled back to the power plant for reuse in the scrubbing section. The sulfur value from the SO_2-rich by-product gas is recovered.

12998 (PB—295011) **Flue gas desulfurization pilot study. phase I. Survey of major installations. Appendix 95-j. Sodium sulfite scrubbing flue gas desulfurization process.** Princiotta, F.; Gerstle, R.W.; Schindler, E. (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 67p. NTIS PC A04/MF A01.

The Wellman-Lord flue gas desulfurization (FGD) process is currently the most recognized regenerable system using soluble sodium sulfite as the scrubbing reagent. Davy Powergas developed the process during the 1960's; the first commercial installation was in 1970 on a sulfuric acid plant. The process has since been applied widely on acid plants, Claus plants, and oil-fired boilers and recently has been installed on a coal-fired boiler. It has treated flue gas with SO_2 concentrations from 1000 to 30,000 ppm at 90 percent or better availability.

12999 (PB—295012) **Flue gas desulfurization pilot study. phase I. Survey of major installations. Appendix 95-k. Carbon-adsorption flue gas desulfurization process.** Haug, N.; Oelert, G.; Weisser, G. (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 43p. NTIS PC A03/MF A01.

This process employs cross-flow adsorption as the Bergbau Forschung Process and regeneration by hot inert gas as the Rheinluft Process. A pilot plant (10,000 cu m/h) was tested in 1969. Since 1972 a 260,000 cu m/h demonstration unit has been operating at Kensai's Sakai Port power station.

13000 (PB—295013) **Flue gas desulfurization pilot study. phase I. Survey of major installations. Appendix 95-l. Copper oxide flue gas desulfurization process.** Princiotta, F.; Gerstle, R.W.; Schindler, E. (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 57p. NTIS PC A04/MF A01.

The copper oxide flue gas desulfurization (FGD) process is one of the few dry processes for controlling sulfur dioxide emissions. The U.S. Bureau of Mines and Shell Corporation developed this process in the early 1960's. Shell continued development and installed a pilot plant at their Permis refinery near Rotterdam in 1967. Later they installed a full-size 36-MW boiler unit at the Yokkaichi refinery in Japan. Although all problems have not been solved, the system effectively removes SO_2 from an oil-fired boiler at an efficiency of 90 percent or greater. The system has not yet been used on a full-scale coal-fired boiler, but a jointly funded U.S. Environmental Protection Agency (EPA) and Tampa Electric Co. (TECO) pilot study has just ended at TECO's Big Bend coal-fired station.

13001 (PETC—0234-T3) **Study of the treatability of wastewater from a coal gasification plant. Annual report, July 15, 1978-July 14, 1979.** Iglar, A.F. (East Tennessee State Univ., Johnson City (USA). Dept. of Environmental Health). Jul 1979. Contract EW-78-S-22-0234. 75p. Dep. NTIS, PC A04/MF A01.

The first year of the study of the treatability of wastewater from the Holston Coal Gasification Plant has been completed. Nearly all the wastewater is recycled to the scrubber-coolers; excess wastewater could not be measured directly, but was estimated at 685 gal/day. Samples were collected from the decanter. Analyses on the raw waste have included BOD (on pretreated), COD, TOC, total solids, total volatile solids, total suspended solids, volatile suspended solids, pH, temperature, ammonia nitrogen, thiocyanate, phenols, sulfide, alkalinity, and grease and oil. These data were analyzed as appropriate to yield mean, standard deviation, weight per day, weight per unit weight of coal consumed, and weight per unit of gas production. Study of pretreatment indicated that essentially any desired degree of removal of ammonia nitrogen could be accomplished by some combination of stripping pH, temperature, aeration rate, and time. A multi-variant linear regression provided an equation which summarized the effects of the four parameters. Evaluation of the removal of grease and oil indicated that gentle aeration would provide improvement over simple pH suppression. Study of biological treatment was undertaken using laboratory-scale activated sludge plants. Treatment effectiveness was over 90% reduction in BOD in early study; later, biological process upsets caused severe deterioration in treatment effectiveness. The biological process upsets appeared related in time to plant operation, especially placing gasifiers in service and out of service, as well as changing the source of coal. It appears that, at Holston and possibly other coal gasification plants, design and operation of wastewater treatment facilities should consider the possibility of upset of biological treatment processes.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 12973, 14192

13002 (PB—291495) **SRC (solvent refined coal) site - specific pollutant evaluation. Volume I. Discussion. Final report November 1977-September 1978.** Hopkins, H.T.; McKeon, K.M.; Thompson, C.R.; Weir, E.E. (Hittman Associates, Inc., Columbia, MD (USA)). Nov 1978. Contract EPA-68-02-2162. 440p. NTIS, PC A19/MF A01.

The report characterizes the potential environmental effects of the multimedia waste streams from the operation of a standard-size Solvent Refined Coal (SRC-I and SRC-II) liquefaction facility utilizing 28,123 Mg of Illinois No. 6 coal per day. The report gives: (1) a more detailed evaluation of the SRC pollutants characterized in a report, Standards of Practice Manual for the SRC Liquefaction Process; (2) an estimate of the potentially adverse effects of pollutant stressors emanating from a hypothetical SRC facility on the Wabash River, White County, Illinois; and (3) substantial background information in a form usable for an Environmental Assessment Report (EAR) on SRC technology. Regulatory standards and guidelines are discussed relative to the emerging synthetic fuels technology. Research needs are identified in terms of SRC technology, monitoring, and environmental sciences. Study results indicate concern for emissions from auxiliary units (e.g., cooling towers, boilers, sulfur recovery), fugitive process discharges, solid wastes, leachate contamination of water, polycyclic aromatic hydrocarbon emissions, hazardous wastes, water treatment effectiveness, interactions within and among media, etc. Volume 2 of the report includes supporting appendices.

13003 (PB—291496) **SRC (solvent refined coal) site--specific pollutant evaluation. Volume 2. Appendices. Final report, November 1977-September 1978.** Hopkins, H.T.; McKeon, K.M.; Thompson, C.R.; Weir, E.E. (Hittman Associates, Inc., Columbia, MD (USA)). Nov 1978. Contract EPA-68-02-2162. 273p. NTIS, PC A12/MF A01.

This volume of the report contains appendices supporting the Volume 1 discussion of the environmental effects of the multimedia waste streams from a standard Solvent Refined Coal liquefaction facility. It provides information on the methodologies involved, including Multimedia Environmental Goals (MEGs) and Source Analysis Methodology (SAM). It also summarizes the 1977 amendments to the Clean Air, Clean Water, and Hazardous Waste Acts. The report provides a compilation of site-specific information as background for the pollutant effects study results given in Volume 1.

RESERVES AND EXPLORATION

13004 (METC/CR—79/18) **Comparison of methods used for determining the natural gas content of coalbeds from exploratory cores.** Chase, R.W. (Marietta Coll., OH (USA). Dept. of Petroleum Engineering). Dec 1979. 27p. Dep. NTIS, PC A03/MF A01.

Several methods are available for determining the natural gas content of coal seams. Such methods generally yield quite different results when applied to the same exploratory core sample taken from a coalbed. A modification of the US Bureau of Mines direct method is presented which utilizes decline curves to approximate the volumes of gas which are recoverable based on exploratory cores from coalbeds. The gas contents of 20 exploratory bituminous coal cores were determined using the indirect, the direct, and the decline curve methods and are summarized in Table 6. A comparison of the values obtained using the three methods for any particular sample reflects significant differences in the estimation techniques. The decline curve approach yields values for recoverable gas content which consistently lie between the values of total gas content found using the indirect and direct methods as witnessed in Table 6. Since the decline curve for a coal sample is a direct representation of the method by which gas is actually released from the coal, the recoverable gas content value obtained for a sample is felt to be more representative of the coal than those values obtained by the indirect and direct methods.

13005 **Regional coal resource update.** Smith, G.E. (Inst. for Mining and Minerals Research, Lexington, KY). pp 9-10 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

Current operations and exploration and drilling programs in the Appalachian Region are briefly reviewed. Specifically, the problems of identifying coal seams and reserve magnitudes in Kentucky are noted. (MCW)

MINING

REFER ALSO TO CITATION(S) 13047, 13048, 13087

13006 (AD-A—062839) **Choosing the overall size of the Strategic Petroleum Reserve. Management sciences research report.** Balas, E. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). May 1978. Contract N00014-75-C-0621. 23p. NTIS, PC A02/MF A01.

The purpose of the Strategic Petroleum Reserve(SPR) is to diminish U.S. vulnerability to, as well as to offer protection against, possible future oil embargoes. This paper formulates the problem of determining the optimal size of SPR as a parametric bimatrix game between the U.S. and its potential opponent. The strategies of the opponent are embargoes of various intensities and lengths, including of course the no embargo option. The strategies of the U.S. are various ways of using the reserve. The size of the reserve itself is a parameter present in both payoff functions. Solving the game for the relevant reserve, as well as on U.S. drawdown policies in case of an embargo. The crucial element in the game-theoretic approach is that, unlike the traditional cost-benefit analysis, it fully captures the embargo-deterrent effect of an appropriate Strategic Petroleum Reserve.

13007 (DOE/IR—0056) **Determinants of coal mine labor productivity change.** Baker, J.G.; Stevenson, W.L. (Oak Ridge Associated Universities, Inc., TN (USA)). Nov 1979. Contract EY-76-C-05-0033. 202p. Dep. NTIS, PC A10/MF A01.

Coal mine labor productivity (tons per miner-shift) has been falling yearly since 1970. The decline in labor productivity since 1970 has implications for the coal industry's labor demand, cost of production, and injuries and could hinder the ability of the industry to meet the coal output goals of the National Energy Plan. The purpose of this research study was to identify and measure the causes of labor productivity decline. Concise answers are given to three questions: Why is coal mine labor productivity important? What are the causes of labor productivity decline in deep and surface coal mines? What are the implications of these findings for future coal mine labor productivity? Coal mine labor productivity is important for three reasons: (1) it affects the cost of coal production, (2) it affects coal industry labor demand, and (3) it affects injuries and injury rates in coal mining. Labor productivity is the link between output levels and employment requirements. The period of declining productivity coincides with major changes in the coal industry's environment: (1) change from a largely unregulated industry to a highly regulated industry (the Coal Mine Health and Safety Act of 1969; implementation of many state surface mine reclamation laws, etc.) and (2) change from a declining, marginal profits industry to a growing, profitable industry (increasing coal prices and demand in the 1970s). A major conclusion of the study is that a portion of the high labor productivity of the 1960s was possible because some of the costs of coal mining - worker injuries, black lung disability, and environmental damage - were not being paid for by the coal industry and coal consumers. Once these costs were forced internally on the mine operators by legislation, productivity fell and the cost of production increased.

13008 (FE—9040-1(App.3)) **Technical assessment of patents related to underground coal mine haulage. Appendix III: other.** Singh, M.M.; Jaspal, J.S.; Presti, R.L.; Hair, R.T.; Yates, G.A. (Engineers International, Inc., Downers Grove, IL (USA)). Nov 1978. Contract ET-76-C-01-9040. 71p. Dep. NTIS, PC A04/MF A01.

A number of patents related to underground mine haulage are described briefly, with comments and diagrams. (LTN)

13009 (FE—9125-1) **Development of shaft lining and service line extension systems compatible with blind shaft borer excavation rates. Phase I. Design. Final technical report.** Halter, J.M.; Eklund, J.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1978. Contract ET-77-C-01-9125. 125p. (PNL—2547). Dep. NTIS, PC A06/MF A01.

This report presents a conceptual design of shaft lining and service line extension systems to be used in conjunction with the Blind Shaft Borer (BSB) developed by the Robbins Company. These systems will allow the BSB to advance at a rate of 50 ft/day on a steady-state basis to depths of 2000 ft. In addition, these systems will ensure that no more than 25 ft of unlined shaft remains above the transfer deck of the BSB at any given time. This design makes use of a mechanized cylindrical form to cast a quick-setting concrete lining 22 ft in diameter. The service lines are suspended from the surface and lowered into the shaft. A description of the design, operation sequences, and performance are presented for both systems. Economic feasibility and feature testing requirements are also described.

13010 (INKA-Conf—79-275-001) **Lecture meeting on cutting technology and costs of roadway drivage with two-slice heading machines.** Mertens, V. (Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.)). 1979. 32p. (In German). (CONF-790165—1). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Lecture meeting on cutting technology and costs of roadway drivage with two-slice roadheaders; Bochum, F.R. Germany (18 Jan 1979).

The paper deals with the fields of application of two-slice heading machines, the improvements in cutting technology, and the costs of roadway drivage with two-slice heading machines.

13011 (ORAU—155) **Coal mine labor productivity: review of issues and evidence.** Baker, J.G.; Gaston, R.J. (Oak Ridge Associated Universities, Inc., TN (USA). Manpower Development Div.). May 1979. Contract EY-76-C-05-0033. 52p. Dep. NTIS, PC A04/MF A01.

Productivity in bituminous coal and lignite mining has declined substantially during the 1970s. This decline has implications on coal industry labor demand, production cost, and worker health and safety. This report reviews existing research that has attempted to explain the productivity decline. The research results reported here indicate that deep mine productivity has been reduced by the Coal Mine Health and Safety Act of 1969, work stoppages, and the 1974 National Bituminous Coal Wage Agreement. In addition, there is strong evidence that manpower shortages have affected productivity. Surface mine productivity has declined because of a reduction in average mine size and state reclamation laws. Future research directions are discussed.

13012 (ORNL/TM—6752) **County coal projections 1975-2000 prepared for the national coal utilization assessment.** Bjornstad, D.J.; Stuckwish, D.N. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 87p. Dep. NTIS, PC A05/MF A01.

This paper describes the computational algorithm used by ORNL to project county coal production and employment levels for the NCUA, and the data and assumptions used to operate this algorithm. This system offers a highly simplified nonbehavioral method to obtain projections for small regions of the United States. The method tends to be highly sensitive to input assumptions regarding coal production levels at the higher regional level, because these levels are used as control totals for small area distributions. Moreover, as production increases the method tends to draw all eligible counties into production rapidly. Nonetheless, this approach does provide a useful way to investigate the credibility of scenarios that contain rapid expansions of the nation's coal extraction sector. The approach emphasizes the relatively remote locations of many reserve beds, while at the same time indicating the degree to which remote beds in many states must be exploited if scenario totals are to be met. As an example of the system's outputs, two projection series have been compared: one based on control totals from the SEAS-AEAR system and one based on ORNL calculations. Poor reserve data quality argues in favor of the simple approach this system employs. (LTN)

13013 (PB—296824) **Comparison of some properties of minesoils and contiguous natural soils. Report no. 1, 1 Sep 75—31 Aug 77 (interim).** Pedersen, T.A.; Rogowski, A.S.; Pennock, R. Jr. (Science and Education Administration, University Park, PA (USA)). Aug 1978. 188p. NTIS, PC A09/MF A01.

Four minesoil pits located within the disturbed area and four natural soil pits located in adjacent undisturbed areas were described and sampled. Bulk densities were determined at ten randomly located sites. Microlysimeters were subsequently installed at these sites and used to determine saturated hydraulic conductivities and evapotranspiration. The most prominent feature of the minesoils was their high degree of coarseness and their high rock fragment content. The weathering of the natural soils has leached bases from them and significantly more extractable aluminum was found in these soils than in minesoils. Organic carbon and nitrogen determinations were affected by the high content of carboniferous shale and coal fragments in the minesoils. The clay minerals present in the minesoils had not been weathered as much as the clay minerals in the natural soils.

13014 (PB—297291) **Relationship of coal properties and machine parameters to continuous mining machine cutting rates. Open file report (final) 15 Oct 76—15 Apr 77.** Finnie, I.; Streit, R.; Foote, L. (MB Associates, San Ramon, CA (USA)). 12 May 1977. Contract J0177009. 74p. NTIS, PC A04/MF A01.

The report is in three parts. The first part presents a review of theoretical models that were developed to study removal operations for various types of materials. The second part is a brief summary of coal cutting research. Most of the work was done in Britain using chisel-type bits rather than the conical picks that are in general use in the United States. A comparison of specific energies measured for conical picks in the laboratory and in the mine shows encouraging correspondence. In the third part of the report, analytical models for coal cutting by picks are suggested. An extension of the British 'tensile breakage' theory, developed for chisels, is given for picks. The role of crushing and cutting in coal removal is discussed as a theory that combines the two processes gives reasonable predictions for specific energy requirements. Finally, directions in which the existing theory could be improved are presented and the need for further research is emphasized.

13015 **Mining machine, particularly for the working of low mine seams.** Oberste-Beulmann, K.; Schupphaus, H.; Borowski, K.H.; Lanfermann, W.; Henrich, F. (to Gebr. Eickhoff Maschinenfabrik und Eisengiesserei m.b.H.). US Patent 4,166,652. 4 Sep 1979. Filed date 10 Jul 1978. 6p.

A drum cutter-loader machine includes discrete units joined together by tie bolts extending transversely to the direction of advancing movement along a face conveyor. The units in succession from the stow side to the working side include a gantry casing supporting winch drive motors and straddling the face conveyor, a transmission box, a winch casing and casing carrying actuators coupled to arms carried by pivots at opposite ends of the winch casing. The arms carry cutter drums driven by motors supported by the arms. A toothed rack at the working face side is engaged by drive wheels driven through gearing in the winch casing and transmission box by the winch motors. The gantry casing is supported at the stow side through runners that engage a guide rail. In one embodiment, the machine is supported by rollers at the working face side on the toothed rack. In a further embodiment, the machine is supported by rollers at the working face side on a machine track.

13016 **Drive frame and assembly for mining apparatus.** Roesler, W. (to Gewerkschaft Eisenhutte Westfaila). US Patent 4,159,851. 3 Jul 1979. Filed date 16 May 1977. 6p.

A drive frame for the drive assembly of a mining installation has a pair of side plates and a connector. The mining installation is of the type having a winning machine and a conveyor. The connector is fastened to one of the side plates of the drive frame and constitutes means for mounting respective drive units for the winning machine and the conveyor. The connector is constituted by a respective mounting plate for each of the drive units. The two mounting plates are connected to one another in a tension-proof manner. The connector is provided with an annular collar which mates with an aperture in said one side plate to support and align the connector.

13017 **Coal mining auger.** Castanoli, A.F. US Patent 4,159,149. 26 Jun 1979. Filed date 18 Mar 1977. 8p.

A coal-mining auger having (a) a hollow, tubular auger head with a spiral or helical coal conveyor mounted therein in concentric relation to the axis of rotation of said auger head, (b) a plurality of coal-cutting bits mounted on said auger head, said bits being orbitally movable with the auger head in circular paths concentric with said axis of rotation, said bits being also concurrently rotatable about their individual axes, and (c) coal-cutting bits which are radially adjustable relative to said axes of rotation. The individually rotatable bits are driven by planetary gear trains which are driven by the main auger shaft.

13018 **Face ventilation system for coal mines.** Kissell, F.N.; Matta, J.E. (to Secretary of Interior). US Patent 4,157,204. 5 Jun 1979. Filed date 27 Jul 1978. 4p.

A coal mine ventilation system which insures proper ventilation near the working area. The basic system employs a mining machine on which is mounted a panel on a movable frame, a conventional line curtain fixed to the mine floor and roof and located adjacent to the panel, and an air control fluid spray system. Fluid sprays may be mounted on the machine on the opposite the panel to promote airflow towards the mining face. Additional sprays may be mounted on the machine panel to provide an effective barrier between that panel and the fixed line curtain.

13019 **Longwall mining machine.** Parrott, G.A.; Greenhough, P. (to Dresser Europe S.A.). US Patent 4,155,598. 22 May 1979. Filed date 12 Dec 1977. 4p.

A longwall mining machine incorporates breaking apparatus comprising an underframe which may be an integral extension of the main underframe of the machine and which is mounted on the conveyor for movement therealong, such that the breaking apparatus is rigidly secured to, and comprises an integral part of, the mining machine. The breaking apparatus also comprises a rotary breaking element drivably carried by the breaker underframe and a reaction plate, for example, on the same underframe, which is spaced from an adjacent periphery of the breaking element. In use, material, such as coal and rocks, on the conveyor passing between the rotary element and the reaction plate is broken against the reaction plate by the rotating breaking element. In this way, the coal and rocks are broken down to a sufficiently small size that they will not become jammed under the main underframe of the mining machine.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 12901, 12934

13020 (DOE/EIA—0184/25) **Evaluation of effects of alternative western freight rates for coal. Analysis report AR/IA/80-04.** Chamberlain, I. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jan 1980. 26p. Dep. NTIS, PC A03/MF A01.

This report presents an analysis of the impact of coal rail transportation costs upon coal production, distribution, and consumption based on runs of the Midterm Energy Market Model (MEMM) using rate structures defined by the Interstate Commerce Commission. Overall levels of coal production in the United States change significantly in response to changes in western freight rates for coal. In addition, significant regional impacts can be expected in the coal producing areas of Northern and Central Appalachia, the Midwest, and the Western Northern Great Plains. Any increase or decrease in western freight rates will have an opposite effect on coal movements crossing the Mississippi River. In general, coal shipments from western producing areas to eastern coal markets are more sensitive to freight rate changes than vice versa. The amount of energy consumed in the United States would be negligibly affected by a change in western freight rates. However, electric utilities would substitute between coal and oil. In general, any freight rate increase would cause the electric utility industry to replace subbituminous fired generating capacity with bituminous units. However, in the West and New York/New Jersey regions, oil would be substituted in place of coal by operating existing distillate and residual units more intensively. Electricity prices are only slightly affected by western coal freight rates for coal. A quadrupling in western rail rates would cause average electricity prices to increase 6 percent.

13021 (EPRI-FP—1226) **Pulverizer failure cause analysis. Final report.** Maloney, K.L.; Benson, R.C. (KVB, Inc., Tustin, CA (USA)). Dec 1979. 121p. Dep. NTIS, PC A06/MF A01.

Large coal pulverizers have been identified by EEI surveys as one of the main systems responsible for lost steam generation capacity of large coal fired utility boilers. This report contains the results of a 16 month study to examine the problem of pulverizer outages and to identify root cause failure modes for the major mill types currently in service. A data base of 469 pulverizers, the majority larger than 40 tons/hr coal capacity, was compiled by surveying the utilities with coal fired boilers in this country. The analysis of this data base combined with telephone interviews and seven field site visits to utilities identified both design and operational problem areas in all of the mill types studied. Five specific problem areas were established and evaluated in this study: (1) drive components, (2) grinding zone, (3) air system, (4) mill fires and explosions, and (5) boiler problems associated with the pulverizer. The root causes of these problems were identified and documented. Recommendations for solutions to some of the more common problems were given after discussion of the findings with the manufactuers.

13022 (FE—2722-6) **Effects of minerals on coal beneficiation processes. Quarterly report No. 6, January 1-March 31, 1979.** McMillan, B.G.; Muter, R.B.; Buttermore, W.H.; Grady, W.C.; Alderman, J.K.; Simonyi, T.; Gierl, D. (West Virginia Univ., Morgantown (USA). Coll. of Mineral and Energy Resources). 15 Jun 1979. Contract EF-77-S-01-2722. 46p. Dep. NTIS, PC A03/MF A01.

Samples of feed coal, clean coal product, and refuse from three commercial coal preparation plants have been processed to yield samples for chemical and mineralogical analysis, physically characterized using screens and float-sink gravity separations, and submitted for extensive chemical analyses. Data collected from this work is being reported as it is available. This report presents a variety of data collected during characterization of the Pocahontas No. 3 sample (southern West Virginia) collected at the District Seven Preparation plant. Calcomp plots of washability data, the screen analysis of the raw coal, a large part of the chemical data obtained from the screen and gravity fractions, and the washability analysis itself are presented. Further characterization of the Pittsburgh sample included correlations between maceral groups, macerals, and mineral matter in head and float-sink fractions. Qualitative mineral distribution trends were also identified for head samples from the Pittsburgh and Pocahontas No. 3 seams using IR. Additional work performed on equipment in the pilot-scale preparation plant to optimize jigging capability is discussed.

13023 (LA—8039-MS) **Costs of coal and electric power production: the impact of environmental control technologies for coal-cleaning plants.** Thode, E.F.; Williams, J.M.; Wewerka, E.M.; Wagner, P. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 25p. Dep. NTIS, PC A02/MF A01.

Costs of 10 alternative environmental control technologies were calculated for three hypothetical and three actual cleaning plants. The cost of lime-limestone slurry coating ranged from $0.22 to $0.50 per ton of product coal. For one actual plant cleaning high-sulfur coal, the range of costs for the 10 alternatives was from $0.076 to $9.89 per ton of product coal, based on March 1978 costs. For the purpose of supplying electric utility customers, coal cleaning reduces the cost of meeting environmental standards because it is less expensive (potentially) to control the water pollution from the coal-cleaning plant than the air pollution from the utility power plant. Applying the less expensive environmental control technology options to coal-cleaning wastes adds approximately 0.2 to 0.4 mills/kWh to the costs of electric power production (1979 costs).

13024 (PB—297690) **Applicability of coal slurry pipelines to the Appalachian region. Volume I. Final report.** Fallah, M.H.; Ciliano, R. (Mathtech, Inc., Princeton, NJ (USA)). Sep 1978. Contract ARC-77-202/CO-5896. 130p. NTIS, PC A07/MF A01.

The study focused on the coal flow network in Appalachia. The coal flows with potential for slurry pipeline applications were then analyzed in a series of case studies using coal demand projections for 1990. For each case study, the cost of coal transportation by a slurry pipeline was determined and compared to that of the competing modes. These case studies indicated that coal slurry pipelines are economicaly viable for Appalachia only in specific cases. The socioeconomic and environmental implications of coal slurry pipelines for the Appalachian Region were analyzed within the context of the highly probable applications.

13025 (PB—297691) **Applicability of coal slurry pipelines to the Appalachian region. Volume II. appendices. Final report.** Fallah, M.H.; Ciliano, R. (Mathtech, Inc., Princeton, NJ (USA)). Sep 1978. Contract ARC-77-202/CO-5896. 166p. NTIS, PC A08/MF A01.

The study focused on the coal flow network in Appalachia. This volume contains the following Appendices: Appendix A - Projection of Coal Flows in Appalachia for 1990; Appendix B - Mathematical Description of the Economic Evaluation Model; Appendix C - Computer Implementation; Appendix D - Case Study Results; and Appendix E - Technical Notes to Volume I.

13026 (PNL—3183) **Coarse coal hydrotransport data predictions.** Lombardo, N.J.; Eyler, L.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 48p. Dep. NTIS, PC A03/MF A01.

This report describes an independent evaluation of the hydrodynamic data obtained with coarse coal in 3- and 6-in. recirculation loops. The measured data are compared with several recently published predictive methods to evaluate data quality and determine data trends. A limited parameterization of these models to investigate their sensitivity is also presented. In recirculating loop tests, velocity ranges of 2 through 15 ft/sec were used to pump solid concentrations of up to 45% by weight. Pressure drop data were obtained for particle-to-pipe diameter ranges to 0.25 under various flow conditions. The predictive methods used to analyze the hydrodynamic data obtained include mechanistic models and empirical correlations. For each method, predicted versus measured headloss gradients were plotted to evaluate the ability of each method to reproduce the parameter trends exhibited by the pressure drop data. Of the five methods selected for analyzing the data, three could be used to predict the head loss gradients with some certainty, including a sliding bed model that provided predicted results equal to a regression analysis of the original data. The original correlation of the data was found to be capable of reproducing 90% of the measured results to within +-30%. It was therefore concluded that the original correlation and the sliding bed model provided sufficient accuracy to be used as a means for estimating the headloss for coarse particle coal systems in 3- and 6-in. lines. The success of the predictive methods in reproducing the parameter trends indicate that the data obtained were reasonably accurate and reliable. It is is expected that mechanistic models can become a valuable design tool for predicting hydrotransport performance over ranges of parameters.

13027 **Process for comminuting and reducing the sulfur and ash content of coal.** Jensen, H.P. (to Chevron Research Co.). US Patent 4,169,710. 2 Oct 1979. Filed date 29 Mar 1978. 4p.

Coal may be effectively comminuted and the ash and sulfur content thereof reduced by contacting the coal with a hydrogen halide such as HF.

13028 **Method for forming coal briquettes.** Anderson, T.J. US Patent 4,169,711. 2 Oct 1979. Filed date 3 Apr 1978. 2p.

Method for forming coal briquettes from coal particles in the size range of 1/4 to 3/4 inch and containing fines in the range of 20 to 40% by volume. The coal particles and fines are mixed with sodium silicate and/or potassium silicate as a binder and are compacted into briquettes at a pressure of 100 to 200 psi, and particularly 140 psi. The resulting briquettes, which are particularly adapted for use as a fuel in home fireplaces, will burn without producing excessive smoke which normally results from burning coal. At the same time, the silicate acts to bond the ash produced during burning such that the burned briquette will maintain its integrity even after it has fully burned and may be removed from a fireplace grate in one piece rather than as loose ash. The briquettes are approximately the size of a wood log in order that they may be conveniently deposited in a fireplace grate.

13029 **Control of dust during coal transportation.** Doeksen, G. (to Cominco Ltd.). US Patent 4,169,170. 25 Sep 1979. Filed date 2 Feb 1977. 8p.

Spraying of coal in an open top hopper car with an aqueous composition containing at least about 2.5% of a binder material consisting of solid material in an aqueous suspension of an asphalt emulsion or a black liquor liqnin product and containing 0.1 to 2.0% of water soluble ethoxylated alkyl phenol or sulfo succinate wetting agent results in the formation of a crust layer which provides protection aganst loss of coal due to wind action during rapid movement of the car.

13030 **Method of manufacturing and installing an inlet line deflector in a centrifugal cyclone for washing coal.** Liller, D.I. US Patent 4,159,073. 26 Jun 1979. Filed date 19 Jul 1978. 26p.

The invention relates to a process for the manufacture of a generally flat triangularly shaped metal deflector for installation to the interior non-tangential surface of an inlet pipe to the bowl of a centrifugal separating cyclone. The deflector constricts the inlet cross section to the bowl by about 19% to about 32%. The process comprises the steps of selecting a pipe section of the same size as the inlet pipe and marking the chord ends at the center angle between 118° and 149°, preferably close to 120°; marking the chord on a template sheet to fix the width of the base of the deflector pattern; determining the length of the deflector at its triangular apex and so marking the template sheet; cutting the sheet at the base and cutting the triangular sides slightly beyond the edges for later trimming near the apex; trimming the top apex of the sheet to form a short straight line parallel to the base and trimming the sides to form arcuate sides, thereby completing the deflector pattern; cutting a metal sheet to the form of the deflector pattern; and welding the cut deflector at its side edges and apex within the pipe at an angle of 8° to 12°.

13031 **Coal washing apparatus.** Walker, L. US Patent 4,159,242. 26 Jun 1979. Filed date 8 Aug 1977. 6p.

An apparatus for separating coarse and fine particles of intermediate specific gravity from an aggregate containing said particles of intermediate specific gravity as well as fine and coarse particles of higher specific gravity by use of a liquid of lesser specific gravity than any of said particles, which apparatus includes a pair of inclined, axially rotating, concentrically disposed helical ribbon flights separately secured within an annular housing such that the rotating action of said flights transports the fine and coarse particles of heavier specific gravity out of the flowing aggregate slurry. The fluid is then drained from the intermediate specific gravity particles passing with the fluid through the lower end of the annular housing in a screened cylinder.

13032 **Treatment of lignite to yield a pumpable fluid.** Lamont, W.E. US Patent 4,080,308. 21 Mar 1978. Filed date 19 May 1977. 3p.

This invention relates to a method for the treatment of lignites which have high inherent water contents in order to form the lignites into readily pumpable fluids. These liquids may be easily transported and stored without the danger of spontaneous combustion. The treatment consists of mixing the solid lignite with a small amount of a dispersing agent such as tetrasodium pyrophosphate, said dispersing agent being added in sufficient amount to adjust the viscosity of the lignite but insufficient to significantly change the solids content.

COMBUSTION

REFER ALSO TO CITATION(S) 12925, 12989, 12991, 13521, 14004, 14045, 14046, 14047, 14048

13033 (DOE/FE—2652) **Prototype anthracite culm combustion boiler/heater unit. Quarterly technical report No. 4, July 1-September 30, 1979.** (Pope, Evans and Robbins, Inc., New York (USA); Foster Wheeler Boiler Corp., Livingston, NJ (USA); Wilkes-Barre, City of, PA (USA)). Jan 1980. Contract ET-78-C-01-2652. 43p. Dep. NTIS, PC A03/MF A01.

There are currently about 910 million cubic yards of anthracite culm (mine refuse) contained in 800 separate banks in a 480 square mile area in the Wilkes-Barre (W-B) anthracite mining region. Although this material represents a significant fuel value, equivalent to approximately 1.25 billion barrels of fuel oil, the culm banks have accumulated because no satisfactory method of combusting this fuel was available until the relatively recent development of the atmospheric fluidized bed (AFB) steam generator. A program was initiated in October 1978 to design, construct and evaluate a 100,000 pph AFB steam generator burning anthracite culm with the addition of fresh anthracite, if required. The unit is to demonstrate the technical, economical and environmental feasibility of producing 150 psig saturated steam for district heating in downtown W-B. Phase I of the program consists of the design of the atmospheric fluidized bed (AFB) plant and a hot model test program. Phase II of the program consists of construction, operation, testing and evaluation of the boiler and boiler plant.

13034 (DOE/SF/10538—T1(Vol.1)) **Preliminary field review updating European R and D efforts. Volume I.** Straus, R.W.; Carsey, J.N.; Dietrich, P. (Galaxy, Inc., Washington, DC (USA)). Nov 1979. Contract AC03-79SF10538. 116p. Dep. NTIS, PC A06/MF A01.

Reports are made on research in individual European countries on: combustion (fluidized-bed, coal-oil mixtures); hot gas cleanup; high-temperature gas turbines; advanced high-temperature corrosion-resistant materials; waste heat recovery, cogeneration, and long-distance heat transmission; fuel cells; improved oil and gas burners; and innovative energy technologies (ocean waves, geothermal). (DLC)

13035 (DOE/TIC—11067) **Computerized decision analysis for atmospheric fluidized bed coal combustion process.** Mallik, A.K.; Byam, J.W. Jr.; Yang, T. (West Virginia Univ., Morgantown (USA). Dept. of Industrial Engineering; Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). 1979. 16p. Dep. NTIS, PC A02/MF A01.

This paper deals with the development of a computerized economic evaluation model for after-tax analysis of capital and operating costs related to Fluidized-Bed Coal Combustion technology which is a new technology for the efficient burning of high sulfur coal while satisfying current EPA emission standards. Using this evaluation model, the economics of the Fluidized-Bed combustion system are compared with conventional coal burning processes for generating steam. This paper discusses the general usage of the computerized economic analysis model, while a computerized cost engineering model is being developed to estimate capital and operating costs of the Fluidized-Bed Coal Combustion system under certain specified conditions.

13036 (LBL—10286) **Calcium sulfate-induced accelerated corrosion.** Akuezue, H.C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 83p. Dep. NTIS, PC A05/MF A01.

Thesis.

In fluidized-bed coal combustion, dolomite or limestone is fed along with the coal to absorb the sulfur. Originally, it was incorrectly expected that the spent acceptor, $CaSO_4$, would not give rise to corrosion problems. However, pilot experience has shown cases of extensive oxidation and sulfidation, which is presumably related to the calcium sulfate deposit. The attack of $CaO/CaSO_4$ and CaO/CaS salt mixtures (1:1) on typical fluidized-bed coal combustor materials in the temperature range 850 to 1100°C and oxygen partial pressures in the range of 10^{-19} to 1 atm (air) were investigated using the following test materials: pure iron, nickel and chromium, Fe-20Cr, stainless steel 310 and Incoloy 800. Also, the effects of the introduction of sulfur-containing gases, carbon as substitute for particles of unreacted coal, and NH_3 into the $CaO/CaSO_4$ mixture were investigated. There appear to be two aspects of $CaSO_4$-induced attack: (a) direct attack by $CaSO_4$ at low temperatures, 950°C and below, which does not involve sulfidation, and (b) complex calcium-iron sulfate liquid-phase attack. A model of the $CaSO_4$-induced accelerated attack on pure iron and iron-base materials is proposed. 29 figures.

13037 (N—79-22623) **Preliminary comparison of theory and experiment for a conical, pressurized-fluidized-bed coal combustor.** Patch, R.W. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Mar 1979. 56p. NTIS PC A04/MF A01.

A published model was used for a comparison of theory with an actual combustor burning caking bituminous coal and using limestone to reduce sulfur dioxide emission. Theoretical bed pressure drop was in good agreement with experiment. The burnable carbon elutriated was not in agreement with experiment, at least partly because the exhaust port was apparently below the transport disengaging height. The observed nitrogen oxides emission rate was about half the theoretical value. There was order-or-magnitude agreement of sulfur dioxide emission rates.

13038 (NTIS/PS—79/0158) **Fluidized bed combustion. Volume 2. 1977 (citations from the NTIS data base). Report for 1977.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 114p. NTIS, PC N01/MF N01.

This bibliography discusses studies on fluidized bed processes and processors for the combustion of fossil fuels, and industrial and municipal wastes. The citations cover fluidized bed boilers and furnaces, sludge incineration, and air pollution control by fluidized bed combustion. (This updated bibliography contains 105 abstracts, none of which are new entries to the previous edition.)

13039 (NTIS/PS—79/0159) **Fluidized bed combustion. Volume 3. 1978-March, 1979 (citations from the NTIS data base). Report for 1978-March 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 326p. NTIS, PC N01/MF N01.

The bibliography cites studies on fluidized bed processes and processors for the combustion of coal, oil, and industrial and municipal wastes. It also covers sludge incineration, fluidized bed boilers, and air pollution control by fluidized bed combustion. (This updated bibliography contains 317 abstracts, 292 of which are new entries to the previous edition.)

13040 (NTIS/PS—79/0160) **Fluidized bed combustion. Volume 2. 1977-March, 1979 (citations from the EngIneering index data base). Report for 1977-March 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 232p. NTIS, PC N01/MF N01.

The cited reports from a worldwide literature survey cover the fluidized bed processes and processors for the combustion of oil, coal, and industrial as well as municipal wastes. It also includes sludge incineration, fluidized bed boilers, and air pollution abatement by fluidized bed combustion. (This updated bibliography contains 225 abstracts, 122 of which are new entries to the previous edition.)

13041 (NTIS/PS—79/0161) **Fluidized bed combustion (citations from the American Petroleum Institute data base). Report for 1964-January 1979.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 106p. NTIS, PC N01/MF N01.

These citations from the American Petroleum Institute pertain to fluidized bed processes and processors for the combustion of oil, coal, natural gas, and industrial and municipal wastes. They also discuss air pollution control by fluidized bed combustion, sludge incineration, fluidized bed boilers and furnaces, and design of the fluidized bed combustors. (Contains 99 abstracts)

13042 (PNL—2850(Pt.4)) **Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.** Nielsen, J.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1979. Contract EY-76-C-06-1830. 121p. Dep. NTIS, PC A06/MF A01.

Separate abstracts were prepared for each of the five sections of this report as follows: coal; fission; geothermal; oil shale; and multitechnology. In addition, abstracts were prepared for six of the nine individual subsections of the section on fission, that relate to dosimetric studies. (ERB)

13043 (PNL—2850(Pt.4), pp 1.1-1.5) **Reaction kinetics of combustion products.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

A mechanism was developed for the formation of submicron fly ash particles during coal combustion. Products of toluene pyrolysis are plotted vs temperature. Fly ash-bound PAHs were deter-

mined at various distances downwind from the stacks of the Colstrip (Montana) power plant; they appear to degrade roughly exponentially with distance. 4 figures, 1 table. (DLC)

13044 (COO—4740-8) **Operation, modification, and maintenance of DOE/PETC 700 H.P. Combustion Test Facility. Quarterly activity report, October 1, 1979-December 30, 1979.** (Management and Technical Services Co., Clairton, PA (USA)). [nd]. Contract EW-78-C-02-4740. 8p. Dep. NTIS, PC A02/MF A01.

Four No. 6 and a 40% coal oil mixture test were run to provide check tests for the parametric test program in the 700 H.P. Combustion Test Facility, which officially completed this test series. The 500 hour endurance test was run without any unscheduled shut downs except to remove an excessive amount of ash which restricted heated gases from entering the convection section of the boiler after 370 hours of operations. During these tests, measurements were made inside the 700 H.P. boiler and at the stack to assess the performance of the combustor. The boiler was instrumented to permit detailed heat balances, emission measurements and flame characterizations. The particulate level in the stack was monitored using isokinetic stack samples and was compared to opacity data obtained from the transmissometer. The size distribution of the particulate matter in the stack was monitored by a cascade impactor. The average emissivity of the flame was determined using various targets and optical pyrometers. The boiler operated almost flawlessly during the 500 hours endurance test. It was necessary to change the burner nozzle every 8 hours to prevent nozzle plugging effecting combustion. Nozzle wear was evident throughout the test until TUNGSTEN CARBIDE inserts were tried during the last 40 hours of testing.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 12971, 12972, 12979

13045 (PB—292106) **Minnesota coal study.** (Minnesota Energy Agency, St. Paul (USA); Minnesota Dept. of Natural Resources, St. Paul (USA); Minnesota Dept. of Transportation, Minneapolis (USA); Minnesota Pollution Control Agency, Roseville (USA); Minnesota State Planning Agency, St. Paul (USA)). Sep 1978. 137p. NTIS, PC A07/MF A01.

This study of coal use in Minnesota involves an analysis of several interrelated factors relative to consumption, transportation and handling, economic implications, and environmental impacts.

13046 Coal and the future economic development of Eastern Kentucky. Harvey, C.E.; Truong, T.V. (Univ. of Kentucky, Lexington). pp 27-31 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

The renewed focus on coal as a principal energy source creates a new opportunity for raising the standard of life of Eastern Kentuckians. In conjunction with private efforts, the objective of public policy should be to further develop the infrastructure of the region, and in particular education and existing skill levels. This is a prerequisite for diversifying the economic base from which future employment and well-being flow. 20 references.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 14191, 14382, 14386

13047 (PB—292324) **Coal mine combustion products identification and analysis--solvents, fire retardants. Annual report, 30 September 1976—19 October 1977.** Paciorek, K.L.; Kratzer, R.H.; Kaufman, J.; Nakahara, J.H. (Ultrasystems, Inc., Irvine, CA (USA)). Oct 1977. Contract H0133004. 118p. NTIS, PC A06/MF A01.

The objective of this program was to develop a reliable and meaningful basis for assessing certain health aspects, namely toxicity hazards created prior to combustion by articles employed in underground coal mining operations. The present investigation was concentrated on halogenated materials, specifically solvents, degreasing agents, fire extinguishants, additives, and conveyor beltings.

13048 (PB—297759) **The Federal Coal Mine Health Program in 1977, annual report (8th) of health activities under the Federal Coal Mine Health and Safety Act of 1969.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jan 1979. 26p. NTIS, PC A03/MF A01.

The report describes the activities and findings of the Federal Coal Mine Health Program in 1977. Included in the report is information on NIOSH findings for medical, epidemiological, industrial hygiene and laboratory research and services. Pneumoconiosis and other non-pneumonoconiotic abnormalities are discussed. Fewer than two percent of the coal miners examined had evidence of pneumonoconiosis; others who had been coal miners for a longer time showed about a 15% incidence of pneumonoconiosis. Projects on diesel equipment, job stress, mortality, clinical, laboratory studies and autopsies as they relate to underground coal miners are discussed.

REGULATIONS

REFER ALSO TO CITATION(S) 13719, 14246, 14247, 14248, 14249

13049 (PB—294708) **Development of new bond release criteria for surface coal mines in the eastern and interior coal provinces of the United States. Open file report (final) 18 jul 77-18 jul 78.** Knuth, W.M.; Fritz, E.L.; Schad, J.A.; Nagle, W.F. (HRB-Singer, Inc., State College, PA (USA). Energy and Natural Resources Dept.). 18 Sep 1978. Contract J0177024. 258p. NTIS PC A12/MF A01.

This study involved a review of bonding and bond release practices in the States of the eastern and midwestern coal provinces. Data was collected from regulatory authorities and site visits to document the bonding and release procedures in the States related to achieving successful reclamation. The regulations related to PL95-87 were reviewed. The analysis included suggested modified or new bond release criteria based on a review of applicable bond release inspection techniques, a conceptual graduated bonding system, and incentive procedures for reclamation of surface mine sites to alternative or higher land uses.

13050 Industrial view of coal mining regulations. McDowell, C.D. pp 21-22 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

The abundance of coal does make it the most logical energy source of energy for the future in America. Mr. McDowell discusses briefly the problems affecting the development of coal - transportation, manpower requirements, declining productivity, shortage of professional and technical personnel, and bureaucratic control of industry. He points out that after the Coal Mine Health and Safety Act of 1969 became effective in April 1970, over 1000 small mines closed voluntarily or were forced to close by overly ambitious mine inspectors. Also, after the law was passed, he adds: "Thousands of regulations were spawned by Washington bureaucrats who had little knowledge of mining but were regulating for regulations' sake." Mr. McDowell comments most adversely on the Surface Mining and Control and Reclamation Act and the ensuing regulations. Even with all the regulatory handicaps faced by the coal industry, however, he feels the industry can still meet the challenge to double production by 1985.

PETROLEUM

13051 (DOE/EIA—0194/7) **Alaskan Hydrocarbons Supply Model: methodology description. Appendix I. Data documentation.** (ICF, Inc., Washington, DC (USA); Shriver (R.) Associates, Washington, DC (USA); van Poollen (H.K.) and Associates, Littleton, CO (USA)). 12 Oct 1979. 386p. Dep. NTIS, PC A17/MF A01.

This report is one of a series documenting the Alaskan Hydrocarbons Supply Model. The model is used to develop midterm projections of oil and gas supply for offshore and onshore regions in Alaska. This data documentation provides data sources, describes any manipulation of the data required to put the data in the proper form, and lists the actual data used in the development of the model.

DRILLING AND PRODUCTION

13052 (BETC—79/4) **Contracts and grants for cooperative research on enhanced oil recovery and improved drilling technology. Progress review No. 20, quarter ending September 30, 1979.** Linville, B. (ed.). (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Jan 1980. 137p. Dep. NTIS, PC A07/MF A01.

The contracts and grants for field projects and supporting research on enhanced oil recovery and improved drilling technology are arranged according to: chemical flooding; carbon dioxide injection; thermal/heavy oil; resource assessment technology; improved drilling technology; residual oil; environmental; and petroleum technology.

13053 (BETC—5075-2) **Basic studies in the displacement of residual oil by chemical flooding. Annual report, February 1, 1978-January 31, 1979.** Flumerfelt, R.W.; Payatakes, A.C.; Tham, M.K. (Houston Univ., TX (USA)). Feb 1980. Contract EY-76-S-05-5075. 37p. Dep. NTIS, PC A03/MF A01.

Research studies at the University of Houston are concerned with (1) the role of dynamic interfacial properties on the displacement and reconnection processes occurring in surfactant flooding processes and (2) the analytical description of multiphase displacement dynamics using ganglia population balance models and simulation algorithms. Tests on oil-water-surfactant systems using both a drop deformation and orientation method and the viscous traction method indicate the largest interfacial viscosities at salt concentrations in the neighborhood of the optimal salinity. Values of interfacial viscosities for crude oil systems were considerably larger than those associated with iso-octane systems. A new technique involving the use of a spinning drop apparatus has been developed for controlled coalescence tests. Tests to date on several iso-octane-brine-surfactant systems and one crude oil-brine-surfactant system indicate that the fastest coalescence occurs at salt concentrations near the point of optimal salinity. Also, the crude oil systems coalesce at significantly slower rates than the iso-octane systems. Capillary displacement tests involving iso-octane drops being displaced by water have been attempted in both constant pressure drop and constant displacement rate systems. Work has continued in the development of a theoretical description of the dynamics of mobilized oil ganglia, their breakup, coalescence, and entrapment. Improvements in the mobilization criteria have been effected, and hundreds of computer-aided stochastic realizations have been performed for solitary ganglia of all sizes of interest moving in a 100 x 200 sandpack. These realizations show clearly that a solitary ganglion gets slenderized as it moves, and that either it gets restranded whole after a few rheons, or that it first breaks into two daughter ganglia, which eventually get stranded.

13054 (BETC/W—26-8) **Chemicals for enhanced oil recovery. Quarterly report, April 1, 1979-June 30, 1979.** Compere, A.L.; Crenshaw, J.M.; Fowler, C.M. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

Sodium-2-ethyloleate of higher purity has been prepared. The shift in alkane number of lowest interfacial tension with increasing surfactant concentration is no longer seen. Interfacial tensions in the millidyne/cm range are still observed, but the minimum for top vs bottom phases appears to be slightly above nonane for both 0.01 M and 0.05 M surfactant, 0.5 M NaCl and 5% ibutyl alcohol, pH 9.8, (the initial aqueous phase). Previously, the minima appeard to be about undecane for 0.01 M surfactant and about octane for 0.05 M. In direct sulfonation of oleamide with SO_3-tributylphosphate complex, an unsaturated sulfonated amide was obtained in yield greater than 90%. Addition of ethoxylated tall oils to petroleum sulfonates broadened the region of three phase behavior. No ultralow interfacial tensions have yet been observed with these mixtures, however. Further studies on the effect of bleach plant effluent from the draft process for pulping of wood in reducing the adsorption of petroleum sulfonates on montmorillonite and on Berea sandstone have clarified some earlier results. Displacment of previously adsorbed surfactant from clay be contact with solutions containing bleach plant effluent was confirmed. Batch bench scale tests of Sporotrichum dimorphosporum QM 806 exolaminarinase showed an improvement in the stability of enzyme activity on scleroglucan in the presence of 10 mM added magnesium. Activity variation with pH was different for scleroglucan and laminarin substrates, with activity maxima at pH3 and 5, respectively. Temperature maxima were above 70 C in both cases.

13055 (DOE/BC/10082—2) **Adsorption from flooding solutions in porous media: a study of interactions of surfactants and polymers with reservoir minerals. Annual report.** Somasundaran, P. (Columbia Univ., New York (USA). School of Engineering and Applied Science). Feb 1980. Contract AC19-79BC10082. 245p. Dep. NTIS, PC A11/MF A01.

Work is reported on three topics: adsorption of surfactants on reservoir minerals, solution chemistry of surfactants, and dynamic studies of the interaction of polymer and surfactant with core minerals. (DLC)

13056 (DOE/RA—0011(79)) **Annual report of operations. Fiscal year 1979.** (Department of Energy, Washington, DC (USA). Office of Resource Applications). 1979. 54p. Dep. NTIS, PC A04/MF A01.

Naval Petroleum Reserve No. 1, known as Elk Hills, has become one of the largest producing oil fields in America. Output is approaching 160,000 barrels each day from recoverable reserves of over one billion barrels of crude oil. Crude oil production at Elk Hills is expected to reach approximately 200,000 barrels per day by 1982. At that time over 900 new wells will have been drilled. Total production in FY 1979 was 52.6 million barrels, bringing revenues to the US Treasury of over $677 million. Production from the two other Naval Petroleum Reserves, No. 2 (Buena Vista Hills) in California and No. 3 (Teapot Dome) in Wyoming have also been adding to the Nation's energy supplies. The three Naval Oil Shale Reserves in Colorado and Utah contain over four billion barrels of economically recoverable shale oil. DOE is proceeding with a congressionally approved multi-year plan to prepare the reserves for commercial scale production.

13057 (PB—296837) **Factbook: onshore facilities related to offshore oil and gas development.** Waitsman, I.M. (New England River Basins Commission, Boston, MA (USA)). Nov 1976. 758p. NTIS, PC A99/MF A01.

An encyclopedic reference work is provided on the principal onshore facilities related to offshore oil and gas development. This book covers temporary and permanent service bases, repair and maintenance yards, transportation facilities, partial processing facilities, gas processing and treatment plants, refineries, platform fabrication yards, pipe coating yards, petrochemical plants, ancillary industries, district offices, and land pipeline systems. It also details the description of the facility, the timing, trends, and options in facility siting, and the characteristics, requirements, and impacts.

13058 (SAN—1864-1) **California thermal oil utilization. Volume I. Executive summary. Final report.** Colman, R.; Standley, E.W. (Science Applications, Inc., La Jolla, CA (USA)). Dec 1979. Contract ET-78-C-03-1864. 385p. Dep. NTIS, PC A17/MF A01.

The potential for significant increases in California thermally produced crude oil (CTO) production and utilization by 1985 was studied. The DOE goal of 900,000 barrels/day of total CTO production by 1985 was evaluated. The constraints to increased CTO production were discussed. Incentives for increasing production were recommended. Physical and chemical properties, conventional refining processes, and alternate technologies for CTO were also discussed. (DC)

13059 (SERI/TR—352-392) **Solar technology application to enhanced oil recovery.** de Leon, P.; Brown, K.C.; Margolis, J.W.; Nasr, L.H. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1979. Contract EG-77-C-01-4042. 101p. Dep. NTIS, PC A06/MF A01.

One proposed near-term commercial application for solar energy technology is the use of solar energy systems to generate steam for thermal enhanced oil recovery (EOR). This report examines four aspects of solar energy employed for steam EOR. First, six solar technologies are evaluated and two - parabolic troughs and central receivers - are selected for closer study; typical systems that would meet current production requirements are proposed and costed. Second, the legal and environmental issues attending solar EOR are analyzed. Third, the petroleum producing companies' preferences and requirements are discussed. Finally, alternative means of financing solar EOR are addressed. The study concludes that within the next four to five years, conventional (fossil-fueled) thermal EOR means are much less expensive and more available than solar EOR systems, even given environmental requirements. Within 10 to 15 years, assuming specified advances in solar technologies, central receiver EOR systems will be significantly more cost-effective than parabolic trough EOR systems and will be price competitive with conventional thermal EOR systems. Important uncertainties remain (both in solar energy technologies and in how they affect the operating characteristics of petroleum reservoirs) that need resolution before definitive projections can be made.

13060 **Economic evaluation of solvent/steam stimulation.** Doscher, T.M.; Ershaghi, I.; Herzberg, D.E.; Gourene, Z.S. (Univ of South Calif, Los Angeles). *J. Pet. Technol.;* **31**: No. 8, 951-954(Aug 1979).

This paper describes the economics of steam/solvent stimulation. The performance of steam-soaking operations, with or without solvent stimulation, is simulated using the Boberg and Lantz analytical model. Indications are that solvents provide no economic advantage in steam-soaking operations where steam/oil ratios are economical. 2 refs.

PROCESSING

REFER ALSO TO CITATION(S) 13089

13061 **Chemistry and processability of crude oil asphaltenes as studied by ultracentrifugation.** Weeks, R.W. Jr. (Los Alamos Scientific Lab., NM); McBride, W.L. *Am. Chem. Soc., Div. Pet. Chem., Prepr.;* **24**: No. 4, 990-1000(Sep 1979). (CONF-790917—(Vol.24)(No.4)).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

One of the problems encountered during high severity hydrocracking of resids is asphaltene precipitation on the catalyst, in reactor effluent lines, and in product blends. Asphaltenes from different crudes show surprising differences in their response to hydrogen processing. Some asphaltenes are remarkably refractory

while others are readily destroyed. These differences are very difficult to relate to analytically determined properties for two reasons: (1) the chemistry of asphaltenes is complex and ambiguous, and (2) defining such properties as reactivity and solubility under process conditions is difficult. In the present study several crude oils were ultracentrifuged and detailed analyses were carried out on the products. The crudes studied were selected to attempt to correlate their hydroprocessability and surface chemistry to results from the ultracentrifuge study. There were substantial differences in the amounts and compositions of the precipitates obtained from various crudes by ultracentrifugation. In samples where equilibrium separations were obtained, the amount of precipitate was generally two to four times the amount of asphaltenes in the crude. This additional material was found to be primarily resins with some oils. Not all the asphaltenes were precipitated at equilibrium at 181,000 g. The amount of the total crude oil heteroatoms (S, N, Ni, and V) concentrated in the precipitates seemed to correlate with ease of hydroprocessing. Two crudes, AB and Magrip, whose resids are known to be difficult to hydroprocess, had high values of the total crude oil heteroatoms that were precipitated. Differences were noted in the nickel- and vanadium-containing compounds as a greater fraction of the total nickel-containing compounds were precipitated.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 12985

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 13064

13062 (PB—294651) **Pipeline accident report-Alyeska Pipeline Service Company, explosion and fire pump station 8, near Fairbanks, Alaska, July 8, 1977.** (National Transportation Safety Board, Washington, DC (USA). Bureau of Accident Investigation). 9 Mar 1978. 45p. NTIS PC A03/MF A01.

At 2:38 p.m., on July 8, 1977, the Alyeska Pipeline Service Company's pump station No. 8, located 17 miles southeast of Fairbanks, Alaska, exploded and then burned. As a result of this accident, one person was killed, five persons were injured slightly, pump station No. 8 was rendered inoperable, and the entire pipeline from Prudhoe Bay to Valdez was shut down. Damage was estimated to be $35 million. The National Transportation Safety Board determines that the probable cause of the accident was the failure of the poorly coordinated and inadequately supervised personnel at pump station No. 8 to follow precisely the written procedures for performing maintenance work and starting the pumps. Contributing to the accident was the absence of a sole authority or station manager in complete control of all activities within the pump station during this critical startup period. Contributing to the amount of crude oil spilled, to the explosion, and to the fire were the inability of the control room personnel to see the activities going on in the pump room, and the lack of controls in the pump room to enable personnel in that location to close or override the valves and to shut down the pump.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 13058, 13690, 13696, 13698, 13700

13063 (DOE/EIA—0102/34) **Expected impact on Gulf Coast and Midwestern residual fuel oil markets of proposed changes to the entitlements program affecting the East Coast residual fuel oil market. Analysis memorandum.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Dec 1978. 33p. Dep. NTIS, PC A03/MF A01.

This analysis memorandum evaluates the impact on Midwestern and Gulf Coast residual fuel oil markets of a proposed rulemaking which would alter the Entitlements Program (Domestic Crude Oil Allocation Program) as it affects the East Coast residual fuel oil market. The memorandum is being prepared at the request of the Economic Regulatory Administration (ERA). If the East Coast, Midwest, and Gulf Coast markets for residual fuel were interconnected, the regulatory changes which occurred in April 1976 should have resulted in increased residual fuel oil (resid) shipments to the Midwest from the Gulf Coast and a reduction in Midwestern prices. Examination of the impact of those changes may provide evidence on the degree of interconnection among the three areas. By some measures, shipments of resid from the Gulf Coast to the Midwest actually declined, while other measures show the expected increases. In conjunction with patterns of local production and the trends in interregional and import shipments, the data make it difficult to determine whether the Midwestern region constitutes a separate or related marketing area for residual oil relative to the East Coast and Gulf Coast. Even if the markets are interrelated, however, the impact of the proposed rulemaking on prices and quantities of residual fuel in hhe Midwest is ambiguous. Elimination of the reverse entitlement penalty on shipments over 5000 barrels/day into the East Coast should tend to reduce shipments into the Midwest; on the hand, extending a full entitlement to imports into the East Coast would tend to lower prices in the East Coast Market and make the Midwest more attractive to Gulf Coast shippers. Due to these offsetting factors, it is difficult to predict whether Midwestern resid prices would rise or fall.

13064 (NTISUB/E/286—004) **International energy statistical review. Monthly report.** (Central Intelligence Agency, Washington, DC (USA)). 4 Apr 1979. 40p. Paper copy also available on subscription, North American Continent price $36.00/year; all others write for quote.

The Review provides current information and comparisons with recent years for a variety of topics on international energy; almost all concern some aspect of the petroleum and natural gas industries. Six charts deal respectively with total Free World oil production, OAPEC oil production, non-Arab oil production, Free World and USSR oil production, inland oil consumption, and net oil imports. In general, the time period covers the last four or five years. The remainder of the Review is made up of 31 tables, covering such disparate topics as production, capacity, reserves, trade, consumption, and stocks. Areas covered include the world, Free World, OPEC, OAPEC, OECD, selected developed countries, Western Europe, China, USSR, and Eastern Europe.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 13073

13065 (AD-A—062693) **Effects of oil slick properties on the dispersion of floating oil into the sea. Final report, September 1976-July 1978.** Milgram, J.H.; Donnelly, R.G.; Van Houten, R.J.; Camperman, J.M. (Coast Guard, Washington, DC (USA). Office of Research and Development). Aug 1978. 340p. NTIS, PC A15/MF A01.

The salient physical effect causing initial dispersion of oil into the sea is breaking waves. Subsequent behavior of the dispersed oil, including droplet trajectories and droplets rejoining the slick are strongly influenced by oceanic turbulence caused by breaking waves and other sources as well. All the aspects of dispersion are related to oil slick properties, the most important being physical and chemical properties of the oil as well as the slick thickness distribution. This report does not give a way of making a quantitative prediction of the extent of dispersion of an oil slick of prescribed properties inasmuch as there is not yet sufficient knowledge to do this. Rather, the report deals with the fundamentals of the dispersing processes and reports the results of a group of laboratory experiments relating to them. These results can ultimately be used in a model for predicting dispersion and also lead to some immediate conclusions. One of them is that the most important slick property influencing dispersion by breaking waves is the oil slick thickness. Thick slicks are much more resistant to dispersion than thin slicks.

13066 (AD-A—067163) **A plan for implementing presidential initiatives concerning oil pollution response. Final report.** Valenti, J.; Leigh, J.; Marsh, G.; Ross, R.; Kuchin, J. (Coast Guard, Washington, DC (USA). Marine Environmental Protection Div.). Oct 1978. 72p. NTIS PC A04/MF A01.

The President's message to Congress on March 17, 1977 outlined major initiatives to be taken to achieve the goal of reducing maritime oil pollution. In response to these initiatives the Coast Guard carried out a series of studies to investigate the feasibility of: Developing a capability to effectively respond to pollution incidents within 6 hours of notification; Developing and maintaining an inventory of equipment to permit the Federal Government to respond to pollution incidents of up to 100,000 tons, and Improving the Federal Government's overall ability to respond to pollution incidents particularly during periods of severe weather. A Task Force was established to integrate the results of the studies that developed the feasibility of meeting these goals and to formulate an implementation plan.

13067 (PB—290917) **Economic impact of the proposed change in the hydrocarbon emission limitation for petrochemical manufacturing process. Final report.** Yates, J.J.; Chaudhry, R.K.; Croke, K.G.; Hallenbeck, W.H.; Kojola, W.H. (ETA Engineering, Inc., Westmont, IL (USA)). Oct 1978. 100p. NTIS, PC A05/MF A01.

The present Rule 205(g) (1) of Chapter 2 of the Illinois Pollution Control Board's Regulations limits organic material emissions from: (a) any catalyst regenerator of a petroleum cracking system; or (b) any petroleum fluid coker; or (c) any other waste gas

stream from any petroleum or petrochemical manufacturing process; to 100 parts per million (ppm). The proposed amendment basically gives the operator of the organic material source the option to meet the less stringent requirements of Rule 205(f). Rule 205(f) requires that the source meet the emission limitation of either 8 pounds per hour or reduce the uncontrolled organic emissions by at least 85 percent provided that there will be no increase in emissions from such sources above the level of emissions in existence on the effective date of R77-3.

13068 (PB—296971) **Alaska OCS socioeconomic studies program. Northern and Western Gulf of Alaska local socioeconomic baseline. Final report.** Smythe, G.; Schultheis, M.C.; Gibson, K.J. (Peat, Marwick, Mitchell and Co., Anchorage, AK (USA); Alaska Consultants, Inc., Anchorage (USA)). 1 May 1979. Contract DI-AA550-CT6-61. 548p. NTIS, PC A23/MF A01.

Before potential impacts of OCS development on a particular community can be adequately assessed, it is first essential to have a good understanding of existing social and economic conditions in that community, the adequacy of that community's infrastructures and its general financial condition. The report provides detailed baseline information for the cities of Yakutat, Cordova, Seward and Kodiak in the areas of population and economy, land use and land tenure, community facilities and services (including utilities), and local government organization and finances. In addition, an analysis of social conditions affecting Yakutat is offered. Two of the communities under study could be impacted by OCS development in the Northern Gulf of Alaska (Yakutat and Cordova) while Kodiak could be impacted by OCS development in the Western Gulf. The fourth community, Seward, could be impacted by OCS development in both areas.

13069 (PB—298016) **Control technology evaluation for gasoline loading of barges. Final report.** Gee, D.; Talbert, W.M. (Pullman Kellogg, Houston, TX (USA)). Mar 1979. Contract EPA-68-02-2619. 105p. NTIS, PC A06/MF A01.

The report gives results of a study to determine the feasibility, safety, and cost of methods to control the emission of hydrocarbon vapor during the loading of gasoline barges. Approximately 4 lb of hydrocarbons are emitted per 1000 gal. of gasoline loaded; annually about 1 million lb of hydrocarbons may be emitted at a terminal pumping 6 million barrels of gasoline. Vapor control techniques evaluated included carbon adsorption, refrigeration, and thermal incineration.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 13006, 13067

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 13062, 13069, 13096

13070 **West to east crude oil transportation systems, required by Title V, Public Law 95-617.** Washington, DC; Bureau of Land Management (Oct 1979). 189p. (NP—24197).

Report to the President.

The Introduction to this report identifies sources of the information available herein, and provides a brief background history of crude oil transportation in the U.S. Part I of this report provides an analysis of crude oil supply and demand within the U.S. Part II is a summary description of the routing and facilities proposed for each of the eligible crude oil transportation systems. Part III is a comparison of each proposed system based on the 16 decision criteria listed in Section 507(b)(1) of Title V, PURPA. Part IV contains the comments and recommendations of the Federal agencies that reviewed this report. Part V lists the State, local and public comments received on the draft of this report. Part VI contains a summary of comments received on the Final Environmental Impact Statement.

PROPERTIES

REFER ALSO TO CITATION(S) 12975, 12981, 13058, 13061, 13950

13071 (DOE/RA/7151—1) **Evaluation of the effects of long-term-storage in salt caverns on the physical and chemical properties of certain crude oils and distillate fuel oils. Final report.** (Kavernen Bau-und Betriebs, G.m.b.H., Hannover (Germany, F.R.); KBB, Inc., Harahan, LA (USA)). Jul 1979. Contract EL-78-C-01-7151. 194p. Dep. NTIS, PC A09/MF A01.

The effects of long-term storage of crude oil and fuel oil in salt caverns were investigated. Fifty oil and brine samples from three caverns in West Germany were analyzed. Results show that: (a) mixing has taken place but variation in properties such as density and viscosity are negligible; (b) some primary theoretical layers are still recognizable, based on the concentration of sulfur, mercaptans, salt, as well as by neutralization number; and (c) mixing occurs more readily when a heavy crude oil is stored above a light crude. It is concluded that crude and fuel oil have not undergone any deleterious changes. (DC)

STORAGE

REFER ALSO TO CITATION(S) 13071

13072 (DOE/BETC/RI—79/13) **Crude oil and finished fuel storage stability: an annotated review.** Brinkman, D.W.; Bowden, J.N.; Giles, H.N. (Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Feb 1980. 71p. Dep. NTIS, PC A04/MF A01.

The Bartlesville Energy Technology Center (BETC) of the Deopartment of Energy (DOE) and the US Army Fuels and Lubricants Research laboratory (AFLRL) at Southwest Research Institute (SwRI) have been working together on a support effort for the Strategic Petroleum Reserve Office (SPRO) of DOE. One task within this effort was a detailed literature survey of previous experiences in long-term storage of crude oil and finished fuels with an emphasis on underground storage. Based on the discussion presented in this review, in the limited number of cases reported, the refinability of crude oil was not significantly affected by prolonged storage. It was found that most crudes will deposit a sludge during storage which may interfere with withdrawal pumping. This sludge is probably composed of wax, sediment, water, and possibly asphaltenes. Emulsions of the water-oil interface have been reported after prolonged storage which have been attributed to action of centrifugal pumps used to remove accumulated seepage water. It is possible that these emulsions resulted from biological activity, such as the anaerobic activity reported, but no hydrogen sulfide production was observed.

13073 (PB—297976) **Reduction of air emissions from gasoline storage tanks. Final report Jan 78—Jan 79.** Gunther, A. (Stop Los Co., West Orange, NJ (USA)). May 1979. Contract EPA-68-02-2679. 39p. NTIS, PC A03/MF A01.

The report gives results of a project to determine the technical and economic feasibility of using flexible plastic membranes to control emissions from gasoline storage tanks. The emission rates and the expected life of the membranes were to be established. A demonstration pilot unit was built and operated. The emission rates were determined, as well as the life expectancy of the membranes. The results indicate that emission control of 99-plus percent, compared to uncontrolled tanks, can be achieved readily, and that the life expectancy of the membranes is in the order of 20 years of continuous service. The estimated installed cost of these devices for commercial application is very competitive with conventionally used floating roofs.

COMBUSTION

REFER ALSO TO CITATION(S) 13044, 13521

NATURAL GAS

REFER ALSO TO CITATION(S) 13051, 13665

13074 (GRI—78/0038(Vol.1)) **Gas Research Institute 1979-1983 Five-Year R and D Plan and 1979 R and D Program. Volume I: development of the Plan.** (Gas Research Inst., Chicago, IL (USA)). Jun 1978. 149p. NTIS.

This volume describes the rationale and methodology behind the five-year plan and summarizes the proposed one-year program. Section II, An Energy Overview, describes GRI's analysis of the energy situation and the role of gaseous energy in the economy. This led to the development of a set of goals and objectives for GRI's program, Section III, Planning Assumptions. The FERC regulations have been clearly established, both within and without the five-year period. This is covered in Section IV relating the objectives of the program to the interest of the ratepayers and the public. Section V summarizes the plan. Section VI, Benefits to the Ratepayer, the results of cost and benefit studies and describes the benefits of the Plan and Program to the ratepayers. GRI's mechanism for implementation of a fomral part of the planning process is described in Section VII. The methodology for GRI's research activities coordi-

nated with other research efforts of national scope, particularly those of DOE, is described in Section VIII. The final section identifies members. (MCW)

13075 (GRI—78/0038(Vol.2)) **1979-1983 Five-Year R and D Plan and 1979 R and D Program. Volume II. Program descriptions.** (Gas Research Inst., Chicago, IL (USA)). Jun 1978. 391p. NTIS.

This volume provides the complete description of the GRI 1979 Program and the 1979-1983 Plan. A summary of the proposed 1979 budget and 5-Year Plan through 1983 is shown. The complete budget, detailed to the project level, is shown. Hoped for co-funding from the Federal government and industry is also identified. Summaries of the projects expected to be funded in 1979 are given. Descriptions of each of the program areas are contained in the subsequent sections. Each section describes the major objectives, ongoing research, and co-funding strategy for that area. Each of the subprograms and projects is described, giving a complete picture of the R and D program at GRI. The 1979-1983 Five-Year R and D plan and 1979 R and D Program described in detail in this volume has been developed in accordance with the principles and planning process set forth in Volume I. The program has been endorsed by GRI's four advisory bodies and was approved by the GRI Board of Directors on March 19, 1978.

13076 (GRI—78/0039) **Gas Research Institute 1979-1983 five-year R and D plan and 1979 R and D program. Executive summary.** (Gas Research Inst., Chicago, IL (USA)). Jun 1978. 35p. NTIS, PC A03/MF A01.

The total budget proposed for 1979 is $40.0 million, with an increase to $102.3 million by 1983. The budget programs cover supply, economics and systems analysis, operations, conservation, basic research, and planning and general administration. Budget allocations for the years 1979 to 1983 are shown in tables. GRI has placed particular emphasis on research in the areas of environment and safety. (MCW)

13077 (GRI—79/0022) **GRI 1980-1984 five-year research and development plan and 1980 research and development program.** (Gas Research Inst., Chicago, IL (USA)). 28 Mar 1979. 208p. NTIS, PC A10/MF A01.

The Gas Research Institute was created in 1976 to plan and implement a comprehensive research and development program for the benefit of the gas consumer. A history, the major program thrusts, and an evaluation of the 1978 program are included in the introductory chapter. Additional chapters are: Gas Option (role of natural gas in the national energy supply, future opportunity for gas use, gas resource considerations, and supply/demand considerations); Objectives, Planning and Coordination; Benefits (supply options, efficient utilization, enhanced service); Priorities; and 1980 budget allocations in the chapter on Program Description (supply, economics and systems analysis, environment and safety, efficient utilization, and basic research. (MCW)

13078 (GRI—79/0023) **GRI 1980-1984 five-year research and development plan and 1980 research and development program.** (Gas Research Inst., Chicago, IL (USA)). Jun 1979. 16p. NTIS, PC A02/MF A01.

A summary of Gas Research Institute's annual document to the Federal Energy Regulatory Commission is presented. GRI's research and development program develops the technology so that the gas ratepayer can continue to receive reliable, safe, low-cost gas service. Specifically, a summary of the events of 1978 is given. Budget allocation summaries are given for the 1979 approved budget, and the planned 1980 to 1984 budgets. Program areas are supply, economics and systems analysis, environment and safety, efficient utilization, and basic research.

GEOLOGY AND EXPLORATION

13079 (DOE/MC/10516—T3) **Shale characterization and resource appraisal of the Devonian black shales of the Appalachian basin. Quarterly report, October-December 1979.** de Witt, W. Jr. (Geological Survey, Reston, VA (USA)). 1979. Contract AI21-79MC10516. 13p. Dep. NTIS, PC A02/MF A01.

Milestones in December are reported for the stratigraphy, geophysics, geochemistry, mineralogy, structure, and resource appraisal of the brown-to-black potentially gas-productive shales in the Appalachian basin. (DLC)

13080 (DOE/MC/10516—T4) **Shale characterization and resource appraisal of the Devonian black shale of the Appalachian Basin. Annual report for FY 1979, October 1, 1978-September 30, 1979.** de Witt, W. (Geological Survey, Reston, VA (USA)). 1979. Contract AI21-79MC10516. 12p. Dep. NTIS, PC A02/MF A01.

Progress in the USGS Devonian Shale Characterization and Resource Appraisal Program covered the following: stratigraphy, geophysics, geochemistry (source bed and trace elements), structural studies, paleontology (conodont maturation), data system, clay mineralogy, and resource appraisal. (DLC)

13081 (DOE/MC/10516—T5) **Appalachian Basin Devonian black shales: regional organic geochemistry and hydrocarbon genesis.** Claypool, G.E.; Threlkeld, C.N. (Geological Survey, Denver, CO (USA)). 24 Oct 1979. Contract AI21-79MC10516. 28p. Dep. NTIS, PC A03/MF A01.

This report emphasizes the geochemical results most relevant to regional evaluation of the Devonian black shale as a source of natural gas. The data tabulated include headspace gas analyses, organic carbon content, thermochemical evolution, pyrolytic hydrocarbon-to-organic carbon ratio, and stable C isotope ratio in methane. (DLC)

13082 (METC/EGSP—100) **Wells penetrating middle and upper Devonian black shales in New York as of January 1978.** Peterson, J.C.; Van Tyne, A.M. (New York State Museum and Science Service, Albany (USA)). 1979. Contract EY-76-S-05-5206. 80p. Dep. NTIS, PC A05/MF A01.

This document comprises two maps. (DLC)

13083 (ORO—5194-T1) **Devonian shale program. Quarterly progress report, April-June 1979.** Negus-de Wys, J.N.; Dixon, J.M.; Evans, M.A.; Lee, K.D.; Long, B.R.; Rauch, H.W.; Ruotsala, J.E.; Williams, R.T.; Wilson, T.H.; Shumaker, R.C. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). 1979. Contract EY-76-C-05-5194. 32p. Dep. NTIS, PC A03/MF A01.

The tabulation of subsurface tops for several formations was completed for the Midway-Extra-Cottageville area, and a production study of the Midway-Extra field was also completed. Other studies (geophysical, fracture, structural, hydrologic) are also reported. (DLC)

13084 (ORO—5194-T2) **Devonian shale program. Quarterly progress report, July-September 1979.** Shumaker, R.C.; Negus-de Wys, J.; Dixon, J.M.; Evans, M.A.; Lee, K.D.; Rauch, H.W.; Ruotsala, J.E.; Williams, R.T.; Wilson, T.H. (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). 1979. Contract EY-76-C-05-5194. 23p. Dep. NTIS, PC A02/MF A01.

Objectives are to analyze the potential natural gas productivity of the Black Shales in eastern Kentucky and western West Virginia. Progress during this quarter is reported on regional structure and production studies. (DLC)

13085 (ORO—5194-T5) **Quarterly progress report, October-December 1979.** (West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography). 1979. Contract EY-76-C-05-5194. 18p. Dep. NTIS, PC A02/MF A01.

Objective was to study gas production from shales in eastern Kentucky and western West Virginia. Work reported include geologic structure studies, maps, etc. (DLC)

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 13057

13086 (EMD—80-8) **Help for declining natural gas production seen in the unconventional sources of natural gas.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 10 Jan 1980. 45p. General Accounting Office, 441 G St., NW, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

Oil imports could be reduced and domestic gas production increased if additional gas production is obtained from four unconventional resources-eastern Devonian shales, tight sands, coal beds, and geopressured zones. Gas produced from these resources can help maintain overall production levels as supplies from conventional gas sources gradually decline. The eastern shales and western sands are the chief potential contributors in the near term. Further demonstrations of coal bed methane's recovery feasibility could improve the prospects for its production while future geopressured methane production remains speculative at this time.

13087 (PB—292314) **Study on Devonian shale, coal seam, and similar special Appalachian gas energy prospects and opportunities. Final report.** (Berger Associates, Harrisburg, PA (USA)). Feb 1978. Contract ARC-77-2/CO-5246. 406p. NTIS, PC A18/MF A01.

This study examines the special developmental opportunities for local, state, regional, and federal programs relating to Devonian Shale, coal seams, and other difficult natural gas sources for maintaining and increasing employment in the Appalachian Region. Governmental and private sector activities are discussed, both encouraging and constraining, along with recommendations and potentials for development. The work researches the technical, economic, and institutional issues and case histories for gas from Devonian Shale, coal seams, and other difficult sources such as gas from deep

drilling, Lake Erie potential, and other low permeable sources. Market characteristics and opportunities are examined for utilities, large and small independent producers, and producer-consumers. A special legal study of methane gas ownership in coalbeds is included.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 12985

13088 (GRI—78/0029) **Preliminary cost benefit analysis of GRI's LNG research program: introduction and summary. Final report.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). 22 Mar 1978. 11p. NTIS.

During the last few years, energy companies have continued to pursue LNG supply projects and have been frustrated by uncertainty in US policy and consequent regulatory delays, as well as public concerns over safety. This report examines the relationship between the economic benefits and costs of LNG, and the effects of the research programs of the Gas Research Institute (GRI).

13089 **Hydrocarbon gas processing.** Campbell, R.E.; Wilkinson, J.D. (to Ortloff Corp.). US Patent 4,157,904. 12 Jun 1979. Filed date 18 Oct 1977. 24p.

A process for separating hydrocarbon gases is described for the recovery of gases such as ethane and heavier hydrocarbons from natural gas streams or similar refinery or process streams. In the process described, the gas to be separated is cooled at a high pressure to produce partial condensation. The liquid from the partial condensation is further cooled and then expanded to a lower pressure. At the lower pressure, the liquid is then separated into fractions in a distillation column. The basic separation process is improved by combining the condensed high-pressure liquid with a stream having a lower bubble point, with cooling of one or both streams prior to expansion.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 13094

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 13696

13090 (PB—294610) **Economic structure and behavior in the natural gas production industry.** Mulholland, J.P. (Federal Trade Commission, Washington, DC (USA). Bureau of Economics). Feb 1979. 179p. NTIS PC A09/MF A01.

The report evaluates the competitive potential of the natural gas production industry. Attention focuses primarily on seller structure within the gas sector, on both a nationwide and regional basis. In a behavioral context, charges of monopolistic supply restraint by the major producers are evaluated by examining the ownership pattern of nonproducing leases in the Federal offshore area. Since Federal price regulation has had a pervasive effect on the gas sector's performance up to the present time, the report's objective is not to evaluate the industry's past performance but, rather, to gauge its potential for workable competition in tthe absence of price regulation in the future.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 13052

13091 (DOE/BC/10003—1) **Western gas sands project. Status report, 1 October 1979-31 October 1979.** (CER Corp., Las Vegas, NV (USA)). 1979. Contract AC08-79BC10003. 93p. Dep. NTIS, PC A05/MF A01.

This report summarizes progress of government-sponsored projects directed toward increasing gas production from the low-permeability gas sands of the western United States. The USGS in Denver continued work toward resource assessment in the four primary study areas. Preparations continue for the coring of the Pacific Transmission Supply Company No. 3-10A Federal well in Sweetwater County, Wyoming, and coring and logging operations were completed at PTS No. 22-12 Federal well, Rio Blanco County, Colorado. Work on fracture conductivity, rock-fluid interaction and log evaluation and interpretation techniques continued at Bartlesville. The Gas Research Institute suspended work on the Rio Blanco 397-19-1 Government well but continued progress on two other projects. Lawrence Livermore Laboratory continued work on hydraulic fracturing mechanics. Los Alamos Scientific Laboratory continued NMR resonance studies. Analyses of the borehole seismic system and the borehole hydrophone system continued at Sandia Laboratories, as well as electromagnetic logging experimentation. Field tests and demonstrations are reported on.

13092 (FE—8385-T1) **Columbia-DOE 10-well project. Technical progress report, January 1980.** (Columbia Gas System Service Corp., Columbus, OH (USA)). Jan 1980. Contract EW-78-C-21-8385. 43p. Dep. NTIS, PC A03/MF A01.

September 1979 marked the initiation of field work on this program. By the end of November, Columbia had drilled/cored, logged and cased all ten project wells. The wellsite locations are in Lorain and Trumbull Counties in Ohio. Significant gas shows occurred in wells Nos. 20150 and 20152 in Lorain County, and well No. 20144 in Trumbull County. Important drilling and logging information is presented, together with hole sizes, casing and cementing programs for each well.

13093 (NVO—0685) **Chemical explosive fracturing devonian shale Kentucky. First annual summary report, July 1, 1976-June 30, 1977.** LaRocca, S.J.; Spencer, A.M. (Petroleum Technology Corp., Redmond, WA (USA)). Feb 1979. Contract EY-76-C-08-0685. 31p. Dep. NTIS, PC A03/MF A01.

This first annual report of DOE Contract No. EY-76-C-08-0685 presents the beginning efforts of a chemical explosive fracturing program to stimulate Devonian shale gas production in eastern Kentucky. A 12-year old below average production gas well was obtained as the first test well in a three well program. Selection was based on geological, off-set well and surface lineament factors. Prior to stimulation, the well was to be cleaned out and flow tested as a data base for post-shot evaluation. Initial clean out was hampered due to water inflow. It became necessary to cement in a new casing liner to seal the wellbore from the subsurface water which had corroded through the old casing. Clean out to total depth was successfully accomplished with a cable too rig. The well is now being flow tested in preparation for chemical explosive stimulation. Gamma ray, temperature and caliper logs, and the procedures for clean out and well testing are appendices to the report.

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 13924

13094 (GRI—77-0010) **Mechanism for the accumulation of static charge on plastic gas pipe installations. Final report.** Kasten, D.G.; Smith, N.A. (Ohio State Univ., Columbus (USA). Dept. of Electrical Engineering). 31 Aug 1979. 82p. NTIS.

Static charge accumulation on plastic gas pipe installations is a result of friction between particulates in the natural gas and the inner pipe surface. A closed-loop test system of two inch plastic pipe with a variable speed blower was constructed and operated with a mixture of air, nitrogen, and various types of particulates. Also, an open-loop natural gas system was tested. The purpose of these test systems was to identify the factors which significantly contribute to charge accumulation, such as pipe geometry, type of particulates, and flow rate. It is not practical to eliminate the mechanism of charge accumulation; however, it is possible to limit the energy in a discharge from a charged pipe to an amount below the minimum ignition energy of a natural gas-air mixture. The relationship between energy in an electrical discharge and the physical and electrical characteristics of an electrode (tool) was determined experimentally. For example, the energy in a discharge can be significantly reduced if the electrode is sharp like a needle and the electrode is grounded through a resistor.

13095 (ORNL/TM—7083) **Inferring network flows from incomplete information with application to natural gas flows.** Hooker, J.N. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 36p. Dep. NTIS, PC A03/MF A01.

A method is detailed for estimating flows along arcs (edges or links) of a network, such as a transportation network, when the total outflow and total inflow at each node (vertex) are known. It proves the optimality of a greedy method of choosing flows for independent estimation so as to determine the other flows, and does so by exploiting an underlying matroid structure. The resulting problem is formulated both as a linear program and a multi-commodity flow problem, and sensitivity analysis is performed. The technique is applied to the estimation of US state-to-state natural gas flows in the years 1974 to 1977, and numerical results are presented; 1974 and 1975 results are checked against actual data. The potential application of the same technique to the estimation of disaggregate data (of any kind), when aggregate and some disaggregate data are known, is pointed out.

13096 (PB—295483) **Alternative liquefied gas cargos: management strategies and vessel design philosophies. Final report.** Marcus, H.S.; Bouthelier, F.J.; Mesavage, C.; Deephouse, C. (Massachusetts

Inst. of Tech., Cambridge (USA). Center for Transportation Studies). Oct 1978. Contract MA-7-38083. 270p. NTIS PC A12/MF A01.

This report analyzes the feasibility of providing single-cargo liquefied gas carriers with the capability to transport alternative liquefied gas cargos. This study addresses the following basic issues: the characteristics of the existing and probable future liquefied gas transportation systems, including cargo movements and liquefied gas terminals; the technology of liquefied gas carriers and associated equipment; the impact on vessel design of incorporating alternative cargo capability; and the impact of federal agencies on the decision-making process. The report provides conclusions and recommendations regarding the conditions under which it may be beneficial to incorporate alternative cargo capability as well as additional information on management strategies.

COMBUSTION

REFER ALSO TO CITATION(S) 12925

OIL SHALES AND TAR SANDS

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 13056

13097 (METC/EGSP—806) **Maps of northern Indiana showing thickness of the Sunbury, Ellsworth, and Antrim shales (New Albany shale equivalents).** Hasenmueller, N.R.; Bassett, J.L. (Indiana State Dept. of Natural Resources, Indianapolis (USA). Geological Survey). 1979. Contract AC21-76MC05204. 32p. Dep. NTIS, PC A03/MF A01.

Maps of Northern Indiana depicting the thicknesses of the Sunbury, Ellsworth, and Antim shales are included.

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

REFER ALSO TO CITATION(S) 13079, 13080, 13081, 13083, 13084, 13085

13098 (METC/CR—80/1) **Chattanooga shale (Devonian and Mississippian) from the Tennessee Division of Geology - US Department of Energy cored drill holes number 1 and 2, Claiborne County, Tennessee.** Roen, J.B.; Milici, R.C.; Kepferle, R.C.; Wallace, L.G. (Geological Survey, Reston, VA (USA); Tennessee Dept. of Conservation, Nashville (USA). Div. of Geology; Geological Survey, Cincinnati, OH (USA)). Jan 1980. Contract AI21-79MC10866. 13p. Dep. NTIS, PC A02/MF A01.

The Chattanooga Shale of the Newman Ridge syncline lies stratigraphically above the Silurian Hancock Dolomite and below the siltstone and shale of the Mississippian Grainger Formation. Core examination indicates that the Chattanooga is predominately a black shale composed of clay, finely divided carbonaceous material, and quartz. Seventy-five % of the sequence cored is black, brownish-black, or grayish-black shale; the remaining 25 percent is made up of lighter shades of gray to greenish-gray clay shale and siltstone. Siltsize quartz is disseminated throughout the unit and also as very thin laminae. Minor to trace amounts of pyrite are common throughout the core.

DRILLING, FRACTURING, AND MINING

REFER ALSO TO CITATION(S) 13093

13099 (LA—7871-PR) **Explosively produced fracture of oil shale. Progress report, October-December 1978.** Schmidt, S.C. (comp.). (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 37p. Dep. NTIS, PC A03/MF A01.

Tracer gas flow and pressure decay of a proposed oil shale retort have been studied using a finite difference formulation of a Darcy fluid flow model. The pressure decay studies were conducted to simulate proposed governmental mine test requirements. Modeling tracer gas flow in a retort illustrates the effect of a tight formation on the overall flow characteristics. Preshot geologic characterization of the highly instrumented single-borehole explosive test shots in the Colony Mine is described. A rate formulation of the anisotropic stress-strain constitutive law is given. The total strain rate used includes both elastic and plastic deformation. An analysis of frictional effects on shear cracks is presented. An initial computational procedure for modeling fracture is presented.

13100 (LA—8024-PR) **Explosively produced fracture of oil shale. Progress report, January-March 1979.** (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 12p. Dep. NTIS, PC A02/MF A01.

The theory describing the average strain resulting from a random distribution of cracks in a stressed medium has been used to determine the reduced modulus of a material containing a distribution of cracks that is isotropic in orientation and exponential in size distribution. The density, porosity, and elastic velocities were determined for oil shale samples taken from a single core from Tract C-a, Colorado. Initial results from two instrumented grout injection tests in the Colony Oil Shale Mine, Grand Valley, Colorado, show that a rapid setting grout can be used to create overstressed regions in selected areas of the mine floor and wall.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 13884, 13885

IN SITU METHODS, TRUE AND MODIFIED

13101 (FE—1747-8) **BX in situ oil shale project. Quarterly technical progress report, March 1-May 31, 1979.** (Equity Oil Co., Salt Lake City, UT (USA)). 20 Jun 1979. Contract ET-78-F-03-1747. 85p. Dep. NTIS, PC A05/MF A01.

Portions of document are illegible.

During the quarter, construction and checkout of Project facilities were completed and Environmental Monitoring and laboratory work continued. Prestartup tasks were completed and a meeting was held to review Project status with all Project personnel. At the end of the quarter all permitting requirements for Project operaton had been met.

13102 (FE—2346-41) **Antrim oil shale-electric heater and propane burner field ignition experiments. Topical report, August 1977-April 1978.** Cole, J.L.; Shannon, J.E. (Dow Chemical Co., Midland, MI (USA). Hydrocarbons and Energy Research Dept.). Oct 1979. Contract EX-76-C-01-2346. 21p. Dep. NTIS, PC A02/MF A01.

The Dow Chemical Company contract with the Department of Energy to investigate the feasibility of recovering energy from Antrim oil shale by an in situ process required that an extraction trial be conducted using wells previously drilled by Dow. During this trial, two systems were used to initiate in situ combustion. An electric heater ignited the shale after two similar heaters were unsuccessful. The failures were due to electric short-circuits and corrosion. Of four attempts to initiate combustion with a propane burner, two were succesful, although considerable difficulty was experienced because the thermocouples placed in the well to provide positive indication of burner ignition were not durable. These results indicate the need for additional developmental work to make the burner more dependable and more easily ignitable.

13103 (LETC—10787-31) **Investigation of the geokinetics horizontal in situ oil shale retorting process. Quarterly report, April-June 1979.** Mankowski, S.G. (Geokinetics, Inc., Concord, CA (USA)). Aug 1979. Contract ET-78-C-03-1787. 175p. Dep. NTIS, PC A08/MF A01.

Drilling and blasting activities for Retorts No. 20, 21, and 22 are reported. The burn of Retort No. 10 was terminated after 100 days of operation. Retort No. 17 was ignited on June 7, 1979 after preliminary pumpdowns. Environmental and socio-economic impact studies are reported. (DLC)

13104 (LETC/RI—79/10) **Simulated in situ retorting of oil shale in a controlled-state retort. II. Heat soaking experiments.** Duvall, J.J. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Dec 1979. 26p. Dep. NTIS, PC A03/MF A01.

Oil shale from the Green River formation has been retorted in three experiments under closely controlled conditions in the controlled-state retort using a very slow heating rate (2.4°F/h). In two of the experiments, all of the shale was retorted and in the third, the bottom 40% of the shale was left unretorted. The oil yield was less than 70% of Fischer Assay for the completed experiments and residual carbon content was higher because of the slow heating rate. Nitrogen and sulfur content of the oils washed from the shale of the interrupted experiment and of the periodic oil samples taken at the retort outlet during the experiment indicate either that nitrogen is more prevalent in the last oils released from the shale and sulfur is prevalent in the first oil released or that there is a chromatographic effect on the oil as it passes over the unretorted shale. Also the amount of bitumen extractable from the partially retorted shale of the interrupted experiment peaks at a lower temperature than for

shales retorted at faster heating rates. These data imply that operators of vertical modified in situ retorts can expect higher concentrations of nitrogen in the oil product at the end of their retort burns and that shale retorted at the fringes of retorts will give lower than ideal yields.

13105 (LETC/RI—80/1) **Simulated in situ combustion retorting in fractures between large blocks of oil shale.** Duvall, J.J. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Jan 1980. 42p. Dep. NTIS, PC A03/MF A01.

True in situ combustion retorting of oil shale in fractures has been simulated in six experiments by igniting the common surfaces between two instrumented blocks of oil shale. Experimental details are given for all experiments although only one of the six experiments became self-sustaining. Three ignition systems were used involving heating the injected gas, heaters between the blocks and heaters in the blocks. The data obtained allow estimation of the heating rates of the oil shale at various places, the rate of combustion zone movement, the amount of shale retorted, and the width of the combustion front. The data show that the fracture between the blocks can be closed down by condensed or coked oil, shale swelling, shale spallation, and shale fusion. Results indicate that longer blocks would be desirable in further experimentation. 18 figures, 7 tables.

13106 (SAN—1747-T3) **BX In Situ Oil Shale Project. Special technical report: surface water hydrology of the Piceance Creek basin and BX In Situ Oil Shale Project, Rio Blanco Country, Colorado.** Dougan, P.M. (VTN Consolidated, Inc., Irvine, CA (USA)). 1 Nov 1979. Contract ET-78-F-03-1747. 75p. Dep. NTIS, PC A04/MF A01.

Objective is to demonstrate the technical feasibility of using superheated steam as a heat-carrying medium to retort in situ the oil shale in the Green River Formation leached zone and provide a mechanism for the recovery of this shale oil with a minimum impact on the environment. One trillion Btu of heat will be injected into a site over two years to retort a shale zone about 550 feet thick and covering about one acre. This document covers studies of basic surface water hydrology conditions.

13107 (SAND—79-2389) **Oil shale programs. Fifteenth quarterly report, July 1979-September 1979.** Stevens, A.L. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Dec 1979. Contract EY-76-C-04-0789. 48p. Dep. NTIS, PC A03/MF A01.

This document describes the work in three programs: (1) Diagnostics and Rock Mechanics Support for the Laramie Energy Technology Center (LETC) In Situ Oil Shale Program;; (2) Advanced Instrumentation and Field Projects for In Situ Oil Shale Processing; and (3) In Situ Bed Preparation Study.

13108 **Vertical stress distribution in oil-shale aggregate columns during retorting.** Thigpen, L.; Heard, H.C. (Lawrence Livermore Lab, Univ of Calif). *Soc. Pet. Eng. J.;* **19**: No. 2, 97-106(Apr 1979).

This paper considers the stresses developed in an oil-shale rubble column during in-situ retorting and assesses the change of the mechanical properties of this rubble mass as a result of the retorting process. New data on the variation of the frictional properties of a 103-dm;sup 3;/Mg grade oil shale with temperature also are presented. Example solutions show that the vertical-stress distribution is a strong function of both the area-to-perimeter ratio and the strong function of both the area-to-perimeter ratio and the coefficient of friction between rubble column and wall rock. Finally, these analyses may be used to give bounds on the dimensions of rubble columns for efficient in-situ retorting operations. 27 refs.

REFINING

13109 (FE—3210-T1) **Addendum to refining to high yields of jet fuels from shale oil. Fourth technical progress report.** vanVenrooy, J.J. (Suntech, Inc., Marcus Hook, PA (USA)). 2 Feb 1979. Contract ET-78-C-01-3210. 16p. Dep. NTIS, PC A02/MF A01.

Whole Paraho shale oil was hydrotreated in Suntech's Pilot Plant to produce between 10 and 15 gallons each of liquid product having a nitrogen content at the 5000, 2000, and 500 ppM N level. Hydrogen consumptions to achieve these various degrees of denitrification were determined. Much additional useful data was obtained on the performance of the Shell 324 nickel molybdate on alumina catalyst in the shale oil system. Operating stability of the system, when running under the most severe conditions, has not been demonstrated with certainty.

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 13042

13110 (LETC/RI—79/9) **Stratigraphic variation of oil shale enthalpy of retorting through the Green River formation on the Colorado C-a tract.** Johnson, D.R.: Smith, J.W.; Young, N.B. (Department of Energy, Laramie, WY (USA). Laramie Energy Technology Center). Dec 1979. 18p. Dep. NTIS, PC A02/MF A01.

The importance of mineral enthalpies for oil shale retorting energy requirements has been largely ignored. A differential scanning calorimetry study of 18 alternating rich and relatively lean oil-yield zones from a core from the Colorado C-a tract shows that mineral enthalpies exceed organic enthalpy in each of the 18 zones. In addition, mineral enthalpy variations are greater than the variations produced by the organic contents of oil shales that have potential oil yields from 7.1 to 31.4 gallons per ton oil shale. Oil shale minerals identified in samples for the study are nahcolite, dawsonite, analcime, magnesian siderite, pyrite, dolomite, illite, quartz, and feldspar.

13111 (PB—291421) **Analysis and characterization of trace elements in shale oil and shale oil products by instrumental neutron activation analysis. Master's thesis.** Shaw, P. (Missouri Univ., Columbia (USA). Dept. of Chemistry). Dec 1978. Contract DI-14-34-0001-8027. 115p. NTIS, PC A06/MF A01.

Trace elements and their mobilization constitute an important consideration in the development of new fossil fuel technologies. Shale oil produced by in situ retorting of oil shale is an alternative fossil energy source. This study deals with the analysis of trace elements in various shale oil products using instrumental neutron activation analysis (INAA). INAA offers several advantages for those elements for which it is applicable. The greatest advantage is the lack of sample preparation prior to analysis, which greatly simplifies the process and prevents sample contamination. The elements for which analyses are reported in this study are aluminum, antimony, arsenic, bromine, cerium, chlorine, chromium, cobalt, copper, gallium, gold, iodine, iron, manganese, mercury, molybdenum, potassium, selenium, sodium, sulfur, tungsten, vanadium, and zinc.

13112 (PNL—2850(Pt.4), pp 4.1-4.13) **Oil shale and tar sand research.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

The chemical composition of potential effluents from an oil shale retort (Paraho) was studied. The elemental abundances of S, As, Fe, Ni, Se, V, and Zn in a surface-retorted shale oil were compared with those in natural crude oils. X-ray fluorescence was used to analyze shale oil and process waters. Radiochemical neutron activation analysis was developed for determining Cd, Se, Te, U, and Zn in oil shale samples. Seven analytical methods were compared for arsenic in oil shale process water. Elemental mass balances were computed for S and ten metals in the Paraho semiworks retort. The mercury released and its chemical species in the Paraho flared product gas were characterized, as was the sulfur species in the retort. A Colorado oil shale is being characterized. A crude shale oil was analyzed by activation and a gamma spectrum presented. 6 figures, 6 tables.

13113 **Characteristics of tar sand bitumen asphaltenes and the effect of asphaltenes on conversion of bitumen by hydropyrolysis.** Bunger, J.W.; Cogswell, D.E.; Zilm, K.W. (Univ. of Utah, Salt Lake City). *Am. Chem. Soc., Div. Pet. Chem., Prepr.;* **24**: No. 4, 1017-1027(Sep 1979). (CONF-790917—(Vol.24)(No.4)).

From American Chemical Society national meeting; Washington, DC, USA (10 Sep 1979).

Asphaltenes and maltenes from a tar sand bitumen were characterized by gross properties and ^{13}C-nmr spectroscopy. While differences between average properties are detected, the gross hydrocarbon structure of the two fractions is virtually identical. Hydropyrolysis was used as a conversion reaction to examine the chemistry of the respective components of the bitumen. Hydropyrolysis converts bitumen to lower average molecular weight liquid products and gases with virtually no coke. Compared to the maltenes, asphaltene species contribute disproportionately to the gaseous and heavy liquid yields, but similarly to the asphaltenes found in the liquid products. Molecules comprising the asphaltene fraction from bitumen are suggested to have average molecular weights in the mid to high hundreds and are broadly distributed with respect to molecular weight, aromaticity, and heteroatom content. Molecules comprising the maltene fraction, while of a lower average molecular weight, aromaticity and heteroatom content, are also broadly distributed and there is substantial overlap between asphaltenes and maltenes with respect to these chemical functionalities. This conclusion is supported by the results of the hydropyrolysis conversion. The results of this study indicate that characterization of bitumen according to compound types is chemically more definitive and more likely to be useful for elucidating conversion mechanisms than are characterizations based on asphaltene content or structure.

DIRECT USES AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 12985

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 14386

MARKETING AND ECONOMICS

13114 (DOE/EIA—0183/15) **US tar sand oil forecasts (1985-1995). Technical report.** Schramm, L.W. (Department of Energy, Washington, DC (USA). Energy Information Administration). Nov 1979. 52p. Dep. NTIS, PC A04/MF A01.

This Technical Report forecasts production of oil from domestic tar sands through 1995 under low, medium, and high world oil price scenarios. It also includes background information such as the extent, nature, and location of tar sands in the United States, as well as the status of technology and a few other pertinent aspects of this potential future source of oil. No appreciable amount of tar sand oil production is anticipated during the forecast period if world oil prices are no higher than those assumed for the medium world oil price path. If the high world oil price trajectory prevails, however, production at a rate of about 50,000 barrels per day is foreseen in 1995.

WASTE RESEARCH AND MANAGEMENT

13115 Solvent solubilization, characterization, and quantitation of aliphatic carboxylic acids in oil shale retort water following chemical derivatization with boron trifluoride in methanol. Riley, R.G.; Shiosaki, K.; Bean, R.M.; Schoengold, D.M. (Pacific Northwest Lab., Richland, WA). Contract EY-76-C-06-1830. *Anal. Chem.;* **51**: No. 12, 1995-1998(Oct 1979).

Boron trifluoride in methanol (BF_3/MeOH) is an excellent reagent for transforming organic solvent insoluble components of oil shale retort water into derivatives which are easier to characterize and quantitate by classical analytical techniques. Treatment of a sample of freeze-dried retort water from the Paraho Oil Shale Demonstration Project (Rifle, Colo.) with BF_3/MeOH converted 28% of the organic carbon in the sample to a benzene soluble form. Capillary gas chromatographic/mass spectrometric analysis of the benzene extract revealed the presence of homologous series of aliphatic monocarboxylic and dicarboxylic acids at concentrations ranging from 3.2 to 138.4 ppM, based on original retort water. These results suggest that this technique in combination with other derivatization techniques can be used to characterize and quantitate water soluble classes of organic components of aqueous process wastes and other environmental samples. 2 tables, 2 figure.

ENVIROMENTAL ASPECTS

REFER ALSO TO CITATION(S) 12910, 13118

13116 (PB—297300) **Seepage through partially saturated shale wastes. Final report 11 jun 75-11 jun 78.** Bloomsburg, G.L.; Wells, R.D. (Idaho Univ., Moscow (USA). Dept. of Agricultural Engineering). Sep 1978. 155p. NTIS, PC A08/MF A01.

This report describes work which was done to apply an existing finite element computer program UNSAT2 to the unsteady, unsaturated flow of water through waste shale piles. The work was done in three phases: Verification of program through comparison with existing data; Verification of program through simulation of flow from field seenage ponds at Rifle, CO.; and application of program to flow due to natural rainfall in a section through the Piceance Basin in Colorado, and a typical waste shale pile.

13117 (UCID—18316) **Toxicity of oil shale retort water to representative aquatic fishes. Progress report.** Harrison, F.L.; Berger, R.; Ireland, R.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 20p. Dep. NTIS, PC A02/MF A01.

The sensitivity of fathead minnow and rainbow trout embryos to oil shale retort water was investigated using static and flow-through bioassays. The continuous renewal of toxicant provided by the flow-through system resulted in mortalities at lower concentrations than in the static system; for the fathead minnow the $LC50_{12}$ was 0.08% in the flow-through and 0.14% in the static bioassay. Embryos of rainbow trout were more resistant to the toxicant than those of the fathead minnow. The incipient lethal concentration in the static bioassay system was between 0.4 and 0.2% for trout embryos and between 0.2 and 0.1% for the fathead minnow embryos. The response of fathead minnow embryos to toxicant changed with age. The most sensitive period appears to be about 24 to 30 hours after spawning when the embryos are undergoing rapid differentiation of the nervous and circulatory systems. Also performed were histochemical tests for the lysosomal enzymes β-glucuronidase and β-glucosamididase. These are ready to be applied to fishes exposed to low levels of oil shale retort water to determine whether sublethal effects on lysosomal structure have occurred. Experiments need to be performed to separate the toxicological effects of the inorganic from the organic constituents of the oil shale retort water and to compare the toxicity of oil shale retort water from different burns. We propose to use the fathead minnow embryo bioassay to obtain this information.

REGULATIONS

13118 (PB—295560) **Colorado West Area Council of Governments: EDA technical assistance project. Final report.** (Economic Development Administration, Washington, DC (USA). Publications Div.). Apr 1979. 9p. NTIS PC A02/MF A01.

The report describes the progress made by a project which provides technical assistance to the four-county area served by the Colorado West Area Council of Governments.

NUCLEAR FUELS

RESERVES

13119 Development and verification of variogram models in roll front type uranium deposits. Knudsen, H.P.; Kim, Y.C. (Univ of Ariz, Tucson). *Min. Eng. (N.Y.);* **31**: No. 8, 1215-1219(Aug 1979).

This paper illustrates the application of geostatistics to a roll front type uranium deposit located in Wyoming. The steps involved in calculation of experimental variograms, variogram modeling, and verification of the resulting models are described in detail. The resulting spherical variogram models for grade thickness and thickness show strong geometrical anisotropies. The major axis of anisotropy for both variables is approximately parallel to the axis of the roll front and the minor axis perpendicular to the roll. This model confirms the technique of drilling "fences" across the roll front, where the drilling is much closer together than the fences along the roll. 9 refs.

EXPLORATION

REFER ALSO TO CITATION(S) 13932, 13937, 13939, 13940

13120 (GJBX—3(80)) **Uranium hydrogeochemical and stream sediment reconnaissance of the Arminto NTMS quadrangle, Wyoming, including concentrations of forty-three additional elements.** Morgan, T.L. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract EY-76-C-13-1664. 242p. (LA—7510-MS). Dep. NTIS, PC A11/MF A01.

During the summers of 1976 and 1977, 570 water and 1249 sediment samples were collected from 1517 locations within the 18,000-km^2 area of the Arminto NTMS quadrangle of central Wyoming. Water samples were collected from wells, springs, streams, and artifical ponds; sediment samples were collected from wet and dry streams, springs, and wet and dry ponds. All water samples were analyzed for 13 elements, including uranium, and each sediment sample was analyzed for 43 elements, including uranium and thorium. Uranium concentrations in water samples range from below the detection limit to 84.60 parts per billion (ppb) with a mean of 4.32 ppb. All water sample types except pond water samples were considered as a single population in interpreting the data. Pond water samples were excluded due to possible concentration of uranium by evaporation. Most of the water samples containing greater than 20 ppb uranium grouped into six clusters that indicate possible areas of interest for further investigation. One cluster is associated with the Pumpkin Buttes District, and two others are near the Kaycee and Mayoworth areas of uranium mineralization. The largest cluster is located on the west side of the Powder River Basin. One cluster is located in the central Big Horn Basin and another is in the Wind River Basin; both are in areas underlain by favorable host units. Uranium concentrations in sediment samples range from 0.08 parts per million (ppm) to 115.50 ppm with a mean of 3.50 ppm. Two clusters of sediment samples over 7 ppm were delineated. The first, containing the two highest-concentration samples, corresponds with the Copper Mountain District. Many of the high uranium concentra-

tions in samples in this cluster may be due to contamination from mining or prospecting activity upstream from the sample sites. The second cluster encompasses a wide area in the Wind River Basin along the southern boundary of the quadrangle.

13121 (GJBX—6(80)) **Survey of lands held for uranium exploration, development, and production in fourteen western states in the six month period ending June 30, 1979.** (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jan 1980. Contract EY-76-C-13-1664. 24p. Dep. NTIS, PC A02/MF A01.

The statistics set forth for the period covered by this report are based on data gathered from records available to the public. These data were derived from public county records of mining claim locations, from the public reports of state and Federal land offices, from commercial reporting services, and from annual reports to stockholders of land companies. Accordingly, if any fee land has been acquired in a private transaction which has not been entered into a public record or report, that land will not be accounted for in this report. The figures for the acreage controlled at the beginning of the calendar year are those that were published for that date in the publication entitled Statistical Data of the Uranium Industry GJO-100(78).

13122 (GJBX—17(80)) **Engineering report on drilling in the Black Hills, South Dakota.** Abou-Zied, S.; Callihan, M.C. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jan 1980. Contract EY-76-C-13-1664. 64p. Dep. NTIS, PC A04/MF A01.

The Black Hills drilling project was conducted by Bendix Field Engineering Corporation (BFEC) in support of the US Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program. The project consisted of five drill holes, ranging in depth from 365 feet (111.25 m) to 564 feet (171.90 m). A total of 2,211 feet (673.91 m) were drilled, all of which were cored. The objective of the project was to obtain subsurface data which would enable us to more accurately assess the favorability of the Precambrian Estes Conglomerate as a host of World Class uranium deposits. Drilling began on August 3, 1979, and concluded on September 7, 1979, with final site restoration and clean-up.

13123 (GJBX—22(80)) **Helium emanometry as an indicator of deeply buried uranium deposits.** Pogorski, L.A.; Quirt, G.S. (Helium Surveys, Inc., Grand Island, NY (USA)). Dec 1979. Contract EY-76-C-13-1664. 389p. Dep. NTIS, PC A17/MF A01.

Helium emanometry has considerable potential for locating deeply buried uranium deposits. In order to determine whether near surface helium-4 anomalies are present over and in close proximity to deeply buried uranium deposits, helium measurements were carried out at three sites having known uranium ore bodies: the Red Desert in Sweetwater County, Wyoming; Copper Mountain in Fremont County, Wyoming; and Spokane Mountain in Stevens Couty, Washington. At each research site, near surface soil and soil gas (probe) samples were collected. Borehole water and soil gas (collector) samples were also taken at selected locations. The samples were analyzed at the laboratory for their helium, light hydrocarbon, and nitrogen content. In most instances it was not necessary to correct the soil gas data. In determining the quantity of helium-4 present in the soil gas samples, the practical precision was +- 50 ppb. The reproducibility of the helium-4 analyses of the water samples varied from +- 5% to +- 20%. The total error in the calculated soil helium-4 levels ranged from 5% to 10% of the value. The calculated corrected soil, water and oil gas helium-4 results were analyzed employing statistical techniques in order to separate the background and anomalous populations. The anomalous population was divided into five subsets for purposes of data presentation. The data are then presented in the form of histograms, dot maps and anomaly contour density maps.One can conclude that the results from this study confirm that near surface helium anomalies are present in the gas of the soil micropores overlying three types of uranium deposits situated in widely differing geological environments. The data obtained from the soil gas (probe) helium samples are also encouraging in that anomalies were found to be present over portions of the known extent of each of the three deposits.

13124 (K/UR—131) **Hydrogeochemical and stream sediment reconnaissance basic data for Laredo NTMS Quadrangle, Texas.** (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). 30 Nov 1979. Contract W-7405-ENG-26. 252p. Dep. NTIS, PC E06/MF E06.

Results of a reconnaissance geochemical survey of the Laredo Quadrangle, Texas are reported. Field and laboratory data are presented for 655 groundwater and 246 stream sediment samples. Statistical and areal distributions of uranium and possible uranium-related variables are displayed. Results of groundwater analysis indicate a north-south trending area in the center of the quadrangle (Duval, Webb, and Zapata Counties) as being most promising for uranium mineralization; these waters are derived mainly from the Catahoula Formation. This groundwater has high concentrations of the uranium pathfinder elements and low concentrations of specific conductance in the high uranium area. Another area showing promise of uranium mineralization is in the northeastern portion of the quadrangle (Jim Wells County) with wells producing from the Evangeline Aquifer. Three areas are indicated by stream sediment data as having potential for uranium mineralization: northwestern Duval and northeastern Webb Counties, northwestern Webb County, and southwestern Webb County. The north central area shows the most promising uranium values from streams draining the Catahoula-Frio Formations and the Jackson Group. Uranium in this area is apparently associated with heavy and/or resistate minerals. The Catahoula also has a large concentration of volcanic ash and is believed to be a major host of uranium in the survey area. Samples from streams draining the El Pico Clay in the northwest have high values of uranium, arsenic, calcium, iron, magnesium, and vanadium. High U-FL values in streams draining the Yegua Formation, in the west central portion of the quadrangle, appear to be associated with high values of aluminum and sodium and to some extent arsenic, calcium, and vanadium.

13125 (LA—8175-PR) **Geostatistics project of the National Uranium Resource Evaluation Program. Progress report, April-September 1979.** Howell, J.A.; Bement, T.R.; Buslee, P.L. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 8p. Dep. NTIS, PC A02/MF A01.

An attempt is underway to develop a uranium favorability index. Thirty-nine openfiled quadrangles are being used in the study. A report is being prepared in cooperation with Bendix Field Engineering Corporation geologists, which will deal with probability distributions in aerial radiometric data.

MINING

REFER ALSO TO CITATION(S) 13179, 13180, 13181, 13580

FEED PROCESSING

REFER ALSO TO CITATION(S) 13153, 13179, 13180, 13181

ENRICHMENT

REFER ALSO TO CITATION(S) 13181, 13580

13126 (RAND/R—2427-DOE) **International arrangements for uranium enrichment.** Mihalka, M.; Miller, M.; Solomon, K.A. (RAND Corp., Santa Monica, CA (USA)). Sep 1979. Contract EN-77-C-01-6139. 108p. Dep. NTIS, PC A06/MF A01.

Current international arrangements for the enrichment of uranium are discussed. Possible developments in those arrangements as a result of apparent trends in the market for enrichment services and technologies are examined. Recommendations to ensure a stable system for the supply of nuclear fuels without markedly increasing the likelihood and risk of future proliferation of nuclear weapons are included. (DC)

CENTRIFUGATION

13127 (K/OA—4420(Rev.2)) **Onsager's pancake approximation for the fluid dynamics of a gas centrifuge.** Wood, H.G. III; Morton, J.B. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.; Virginia Univ., Charlottesville (USA)). Jan 1980. Contract W-7405-ENG-26. 60p. Dep. NTIS, PC A04/MF A01.

A previously unpublished theory for describing the internal flow in a gas centrifuge is presented. The theory is based on boundary layer type arguments on the side walls of the centrifuge with the additional approximation of neglecting radial diffusion of radial momentum. The effects of the top and bottom end caps are incorporated through Ekman layer solutions. The results are presented in a form amenable to numerical calculations. Some sample calculations are presented for the special case of a centrifuge with a linear temperature profile on the wall and the top and bottom of the centrifuge at the same temperature as the corresponding end of the side wall.

13128 (Y/DS—109) **Effect of short-term material balances on the projected uranium measurement uncertainties for the gas centrifuge enrichment plant.** Younkin, J.M.; Rushton, J.E. (Oak Ridge Y-12 Plant, TN (USA)). 5 Feb 1980. Contract W-7405-ENG-26. 26p. Dep. NTIS, PC A03/MF A01.

A program is under way to design an effective International Atomic Energy Agency (IAEA) safeguards system that could be applied to the Portsmouth Gas Centrifuge Enrichment Plant (GCEP). This system would integrate nuclear material accountability with containment and surveillance. Uncertainties in material balances due to errors in the measurements of the declared uranium streams have been projected on a yearly basis for GCEP under such

a system in a previous study. Because of the large uranium flows, the projected balance uncertainties were, in some cases, greater than the IAEA goal quantity of 75 kg of U-235 contained in low-enriched uranium. Therefore, it was decided to investigate the benefits of material balance periods of less than a year in order to improve the sensitivity and timeliness of the nuclear material accountability system. An analysis has been made of projected uranium measurement uncertainties for various short-term material balance periods. To simplify this analysis, only a material balance around the process area is considered and only the major UF_6 stream measurements are included. That is, storage areas are not considered and uranium waste streams are ignored. It is also assumed that variations in the cascade inventory are negligible compared to other terms in the balance so that the results obtained in this study are independent of the absolute cascade inventory. This study is intended to provide information that will serve as the basis for the future design of a dynamic materials accounting component of the IAEA safeguards system for GCEP.

LASER EXCITATION

REFER ALSO TO CITATION(S) 14573

13129 (Y/DA—6671) **Argon gas scattering cell to protect windows from uranium vapor.** McNeely, J.R. (Oak Ridge Y-12 Plant, TN (USA)). 19 Feb 1976. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

The efficiency of an argon gas scattering cell for attenuating uranium vapor was measured. Attenuation efficiencies up to 0.9997 of the incident vapor intensity were observed with a gas scattering cell 15.24 cm in length and 1.05 cm in diameter (ID). Cell argon densities were on the order of 10^{13} to 10^{14} atoms-cm^{-3}.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 13181

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 13038, 13039, 13040, 13041, 13184, 13580, 13583, 13970

13130 (ANL—78-76) **Chemical Engineering Division Fuel Cycle Programs. Quarterly progress report, April-June 1978.** Steindler, M.J.; Ader, M.; Barletta, R.E. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 301p. Dep. NTIS, PC A14/MF A01.

Fuel cycle studies reported include development of centrifugal contactors for Purex processes. Tricaprylmethyl-ammonium nitrate and di-n-amyl-n-amylphosphonate are being evaluated as Thorex extractants. Dispersion of uranium and plutonium by fires, and mechanisms for subdividing and dispersing liquids and solids were reviewed. In the pyrochemical and dry processing program, a facility for testing containment materials is under construction; a flowsheet for carbide fuel processing has been designed and studies of carbide reactions in bismuth are underway; salt transport processes are being studied; process-size refractory metal vessels are being fabricated; the feasibility of AIROX reprocessing is being determined; the solubility of UO_2, UO_2 + fission products, and PuO_2 in molten alkali metal nitrates, has been investigated; a flowsheet was developed for reprocessing actinide oxides in molten salts; preparation of Th-U carbide from the oxide is being studied; new flowsheets based on the Dow Aluminum Pyrometallurgical process for reprocessing of spent uranium metal fuel have been prepared; the chloride volitility processing of thorium-based fuels is being studied; the reprocessing of $(Th,U)O_2$ solid solution in KCl-LiCl-$ThCl_4$-Th is being studied; and a flowsheet for processing spent nuclear fuel in molten tin has been constructed. Leach rates of simulated encapsulated waste forms in a metal matrix were studied. Nine criteria for handling waste cladding hulls were established. Strontium and tin migration in glauconite columns was measured. Radioactive Sr in a stream of water moved through oolitic limestone as rapidly as water, but in a stream of water equilibrated with the limestone, Sr moved through the limestone one-tenth as fast. Migration of trace quantities of Cs and I through kaolinite was studied. 88 figures, 53 tables.

13131 (PNL—2080-16) **Calculated critical parameters in simple geometries for oxide and nitrate water mixtures of U-233, U-235 and Pu-239 with thorium. Final report.** Converse, W.E.; Bierman, S.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Nov 1979. Contract EY-76-C-06-1830. 74p. Dep. NTIS, PC A04/MF A01.

Calculations have been performed on water mixtures of oxides and nitrates of ^{233}U, ^{235}U, and ^{239}Pu with chemically similar thorium compounds to determine critical dimensions for simple geometries (sphere, cylinder, and slab). Uranium enrichments calculated were 100%, 20%, 10%, and 5%; plutonium calculations assumed 100% ^{239}Pu. Thorium to uranium or plutonium weight ratios (Th: U or Pu) calculated were 0, 1, 4, and 8. Both bare and full water reflection conditions were calculated. The results of the calculations are plotted showing a critical dimension versus the uranium or plutonium concentration. Plots of K-infinity and material buckling for each material type are also shown.

13132 (PNL—2985) **Cladding hull decontamination process: preliminary development studies.** Griggs, B.; Bryan, G.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 63p. Dep. NTIS, PC A04/MF A01.

An investigation of the chemical and radioactive properties of fuel hulls was conducted to assist in a decontamination process development effort. The removal of zirconium oxide layers from zirconium was accomplished by a treatment in 600°C HF followed by a dilute aqueous reagent. Similar treatment in fused alkali-zirconium fluoride salt baths was examined. A remotely operated small batch facility was developed and process parameters determined. 16 figures, 9 tables.

13133 (PNL—3153) **Comparative techniques for nuclear fuel cycle waste management systems.** Pelto, P.J.; Voss, J.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 177p. Dep. NTIS, PC A09/MF A01.

A safety assessment approach for the evaluation of predisposal waste management systems is described and applied to selected facilities in the light water reactor (LWR) once-through fuel cycle and a potential coprocessed UO_2-PuO_2 fuel cycle. This approach includes a scoping analysis on pretreatment waste streams and a more detailed analysis on proposed waste management processes. The primary evaluation parameters used in this study include radiation exposures to the public from radionuclide releases from normal operations and potential accidents, occupational radiation exposure from normal operations, and capital and operating costs. On an overall basis, the waste management aspects of the two fuel cycles examined are quite similar. On an individual facility basis, the fuel coprocessing plant has the largest waste management impact.

13134 (RHO-LD—74) **Purex process solvent: literature review.** Geier, R.G. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Oct 1979. Contract EY-77-C-06-1030. 185p. Dep. NTIS, PC A09/MF A01.

This document summarizes the data on Purex process solvent presently published in a variety of sources. Extracts from these various sources are presented herein and contain the work done, the salient results obtained, and the original, unaltered conclusions of the author of each paper. Three major areas are addressed: solvent stability, solvent quality testing, and solvent treatment processes. 34 references, 44 tables.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 13163, 13176, 14021

13135 (AGNS—35900-1.2-45) **Studies and research concerning BNFP: spent fuel disassembly and canning programs at the Barnwell Nuclear Fuel Plant (BNFP).** Townes, G.A.; Rogell, M.L.; Anderson, R.T. (Allied-General Nuclear Services, Barnwell, SC (USA)). Oct 1979. Contract ET-78-C-09-1040. 82p. Dep. NTIS, PC A05/MF A01.

Methods of disassembling and canning spent fuel to allow more efficient storage are being investigated at the BNFP. Studies and development programs are aimed at dry disassembly of fuel to allow storage and shipment of fuel pins rather than complete fuel assemblies. Results indicate that doubling existing storage capacity or tripling the carrying capacity of existing transportation equipment is achievable. Disassembly could be performed in the BNFP hot cells at rates of about 12 to 15 assemblies per day.

13136 (AGNS—35900-1.3-47) **Studies and research concerning BNFP. Spent fuel disassembly: increasing hot-cell storage capacity at the Barnwell Nuclear Fuel Plant.** Anderson, R.T. (Allied-General Nuclear Services, Barnwell, SC (USA)). Oct 1979. Contract ET-78-C-09-1040. 82p. Dep. NTIS, PC A05/MF A01.

This report presents the results of work performed at AGNS in 1979 related to production-rate fuel disassembly in the existing hot cell spaces of the BNFP. The primary advantage of the developed technique is realized at a reprocessing plant facility where suitable hot cells and connecting storage pools are available. The existing spent fuel pools are also candidates for away-from-reactor (AFR) storage space. Storage estimates based on utilization of the BNFP indicate that a major expansion from 1600 MTU up to 3000 MTU is possible. The report presents data on the results of initial process development and prototype equipment testing. Assessments were made of operational safety, licensing, and economic factors. These

studies indicate that the techniques are performable and have economic merit when there is a requirement for a large increment of new storage capacity. A development program plan is presented. This plan delineates the future work required to bring the process to a point where implementation is possible.

13137 (AGNS—35900-1.4-59) **Studies and research concerning BNFP. Nuclear spent fuel transportation studies.** Anderson, R.T.; Maier, J.B. (Allied-General Nuclear Services, Barnwell, SC (USA)). Nov 1979. Contract ET-78-C-09-1040. 63p. Dep. NTIS, PC A04/MF A01.

Currently, there are a number of institutional problems associated with the shipment of spent fuel assemblies from commercial nuclear power plants: new and conflicting regulations, embargoing of certain routes, imposition of transport safeguards, physical security in-transit, and a lack of definition of when and where the fuel will be moved. This report presents a summary of these types and kinds of problems. It represents the results of evaluations performed relative to fuel receipt at the Barnwell Nuclear Fuel Plant. Case studies were made which address existing reactor sites with near-term spent fuel transportation needs. Shipment by either highway, rail, water, or intermodal water-rail was considered. The report identifies the impact of new regulations and uncertainty caused by indeterminate regulatory policy and lack of action on spent fuel acceptance and storage. This stagnant situation has made it impossible for industry to determine realistic transportation scenarios for business planning and financial risk analysis. A current lack of private investment in nuclear transportation equipment is expected to further prolong the problems associated with nuclear spent fuel and waste disposition. These problems are expected to intensify in the 1980's and in certain cases will make continuing reactor plant operation difficult or impossible.

13138 (BAW—1484-7) **Critical experiments supporting close proximity water storage of power reactor fuel. Technical progress report.** Baldwin, M.N.; Hoovler, G.S.; Eng, R.L.; Welfare, F.G. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Jul 1979. Contract EY-77-C-09-1001. 103p. Dep. NTIS, PC A05/MF A01.

Close-packed storage of LWR fuel assemblies is needed in order to expand the capacity of existing underwater storage pools. This increased capacity is required to accommodate the large volume of spent fuel produced by prolonged onsite storage. To provide benchmark criticality data in support of this effort, 20 critical assemblies were constructed that simulated a variety of close-packed LWR fuel storage configurations. Criticality calculations using the Monte Carlo KENO-IV code were performed to provide an analytical basis for comparison with the experimental data. Each critical configuration is documented in sufficient detail to permit the use of these data in validating calculational methods according to ANSI Standard N16.9-1975.

13139 (HEDL-TC—1331) **Materials interaction test summary description.** Krogness, J.C. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1980. Contract EY-76-C-14-2170. 14p. Dep. NTIS, PC A02/MF A01.

The Materials Interaction Test is designed to provide early scoping data on host rock performance and interaction between nuclear waste canister materials and host repository media under conditions representative of expected disposal environments. Capsules containing these materials were put in a spent fuel assembly and subsequently placed in a disposal test to study behavior in a low-level radiation environment at temperatures expected to range between 300 and 400°F. Thermal control capsules are being exposed in laboratory furnaces to allow a determination and separation of thermal and radiation effects. Post-test specimen examinations are planned to determine material property changes and interaction effects and provide data for understanding the effectiveness of host rock, canister, and cladding materials in long-term waste isolation.

13140 (HEDL-TME—78-58) **Spent fuel integrity during transportation.** Funk, C.W.; Jacobson, L.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1980. Contract EY-76-C-14-2170. 54p. Dep. NTIS, PC A04/MF A01.

The conditions of recent shipments of light water reactor spent fuel were surveyed. The radioactivity level of cask coolant was examined in an attempt to find the effects of transportation on LWR fuel assemblies. Discussion included potential cladding integrity loss mechanisms, canning requirements, changes of radioactivity levels, and comparison of transportation in wet or dry media. Although integrity loss or degradation has not been identified, radioactivity levels usually increase during transportation, especially for leaking assemblies.

13141 (NUREG/CR—0931) **Transportation of radioactive material in Georgia. Report for 1 Aug 77-30 Sep 78.** Carter, M.W.; Gasper, J.T.; Kahn, B. (Georgia Dept. of Human Resources, Atlanta (USA); Georgia Inst. of Tech., Atlanta (USA). Office of Interdisciplinary Programs). Jul 1979. Contract NRC-06-77-021. 58p. NTIS, PC A04/MF A01.

Shipments of radioactive materials were surveyed to determine the types of materials, pattern of transportation and magnitude of activity, the extent of compliance with shipping regulations, and the radiation exposure to persons handling the materials. The transported radioactive materials were categorized as radiopharmaceutical packages, packages for industrial, research or educational use, teletherapy and radiography sources, and nuclear fuel cycle shipments. Radiopharmaceuticals constituted the most numerous shipments, but the highest curie amounts were in spent fuel elements. The transportation workers whose radiation dose rates were measured did not receive excessive increments from the radioactive materials, but practices for reducing their radiation doses can be instituted and are recommended.

13142 (NVO—210) **Safety Assessment Document for the Spent Reactor Fuel Geologic Storage Test in the Climax Granite Stock at the Nevada Test site.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Jan 1980. 250p. Dep. NTIS, PC A11/MF A01.

The objective of the Spent Fuel Geologic Storage Test in the Climax Granite Stock is to evaluate the response of a granitic rock mass to the underground storage of encapsulated spent reactor fuel in a geometry that simulates a module of a large-scale geologic repository. This document reports an assessment of the safety of conducting this test. Descriptions are provided of the geography, meteorology, hydrology, geology, and seismology of the Climax Site; the effects of postulated natural phenomena and other activities at the nevada Test Site on the safety of the test; and the design and operation of the test facility and associated equipment. Evaluations are made of both the radiological and nonradiological impacts of normal operations, abnormal operations, and postulated accidents. It is concluded that conduct of the spent fuel test at the Climax Site will not result in any undue risk to the public, property, environment, or site employees.

13143 (PNL-SA—6519) **Placing the special trains issue in perspective.** Rhoads, R.E.; Chais, M.; DeSteese, J.G.; Loscutoff, W.V. (Battelle Pacific Northwest Labs., Richland, WA (USA)). May 1978. Contract EY-76-C-06-1830. 7p. Dep. NTIS, PC A02/MF A01.

The contention of the Association of American Railroads (AAR) that special trains are necessary for handling spent fuel is discussed. These special trains would not move faster than 35 mph nor carry any nonradioactive freight. When a special train meets, passes, or is passed by another train, one train would stand still while the other moves past at a speed of less than 35 mph. The shippers feel these special trains are not necessary and that they would increase the cost of transporting spent fuel possible alternatives to the current standoff between railroads and shippers of radioactive material are mentioned.

13144 (SAND—79-2262) **Proceedings of the nuclear materials transportation program development seminar.** (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 224p. (CONF-7904121—). Dep. NTIS, PC A10/MF A01.

From Nuclear materials transportation program development seminar; Albuquerque, NM, USA (18 Apr 1979).

This document includes viewographs (overview, systems developments, technology, information and institutional issues), discussions, workshop reports, points of agreement and action items, and independent summary.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 13133, 13181, 13964

13145 (PB—295360) **Characterization of selected low-level radioactive waste generated by four commercial light-water reactors.** (New York State Energy Research and Development Authority, New York (USA); Dames and Moore, White Plains, NY (USA)). Dec 1977. Contract EPA-68-01-3294. 78p. NTIS PC A05/MF A01.

An investigation was made of the radionuclide makeup of light-water nuclear reactors' radioactive wastes presently being consigned to shallow land burial. The studies were contracted through the New York State Energy Research and Development Authority and consisted of radiochemical analyses of spent ion exchange resins, evaporator concentrates and filter sludges for specific radionuclides including activation products, fission products and transuranics. Ten waste samples were obtained from two BWRs and two PWRs.

13146 (PB—295408) **An analysis of low-level solid radioactive waste from lwrs through 1975.** Phillips, J.W.; Gaul, G.A. (Office of Radiation Programs, Washington, DC (USA). Technology Assessment Div.). Nov 1977. 106p. NTIS PC A06/MF A01.

In view of the wide disparity of data bases and conflicting conclusions, this study updates a previous EPA study. In addition, this study also provides a break down of projected annual volumes by type of waste, i.e., demineralizer resins and filter sludge, evapora-

tor bottoms, and contaminated trash, and also identify the relative composition of the wastes by major nuclides. These latter results will be compared with similar results from other studies.

13147 (RHO-LD—79-101-D) **Long-term high-level defense waste technology. Progress report, July-September 1979.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1979. Contract EY-77-C-06-1030. 37p. Dep. NTIS, PC A03/MF A01.

Progress is reported in program management and support, waste preparation, and waste fixation. 3 figures, 5 tables. (DLC)

13148 (SAND—79-1245) **Gas generation from transuranic waste degradation: data summary and interpretation.** Molecke, M.A. (Sandia Labs., Albuquerque, NM (USA)). Dec 1979. Contract EY-76-C-04-0789. 71p. Dep. NTIS, PC A04/MF A01.

A comprehensive review of all applicable gas generation data resulting from the degradation of existing and potential forms of transuranic-contaminated wastes is presented. Extensive experimental studies have been performed under both realistic environmental conditions expected in the Waste Isolation Pilot Plant and overtest conditions. Degradation mechanisms investigated were radiolysis, thermal decomposition and dewatering, bacterial action, and chemical corrosion. Waste matrices studied include cellulosics, plastics, rubbers, organic composite, concrete-TRU ash, asphalt, process sludges, and mild steel. Measured gas generation rates are presented in terms of gas moles/year/drum of waste and in G(gas) values for radiolysis. The effects of multiple variables on gas generation are also described. 7 figures, 15 tables.

13149 (UCRL—15168) **Pre-sealing risk analysis.** Ensminger, D.A.; Hough, M.E.; Oston, S.G. (Analytic Sciences Corp., Reading, MA (USA)). 7 Jan 1980. Contract W-7405-ENG-48. 85p. Dep. NTIS, PC A05/MF A01.

This report describes studies of accidents involving high-level radioactive waste before sealing the waste into a repository. The report summarizes work done in this area during Fiscal Year 1978 and supplements previous work. Models of accident probability, severity, and consequences are refined and extended.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 13132

13150 (ANL/EIS—11) **Generic waste management concepts for six LWR fuel cycles.** DePue, J.D. (ed.). (Argonne National Lab., IL (USA)). Apr 1979. Contract W-31-109-ENG-38. 123p. Dep. NTIS, PC A06/MF A01.

This report supplements the treatment of waste management issues provided in the Generic Environmental Statement on the use of recycle plutonium in mixed oxide fuel in light water cooled reactors (GESMO, NUREG-0002). Three recycle and three no-recycle options are described in this document. Management of the radioactive wastes that would result from implementation of either type of fuel cycle alternative is discussed. For five of the six options, wastes would be placed in deep geologic salt repositories for which thermal criteria are considered. Radiation doses to the workers at the repositories and to the general population are discussed. The report also covers the waste management schedule, the land and salt commitments, and the economic costs for the management of wastes generated.

13151 (DPST—79-294) **Glass as a matrix for SRP high-level defense waste.** Wiley, J.R.; Bibler, N.E.; Dukes, M.D.; Plodinec, M.J. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jan 1980. Contract EY-76-C-09-0001. 53p. Dep. NTIS, PC A04/MF A01.

Work done at Savannah River Laboratory and elsewhere that has led to development of glass as a candidate for solidifying Savannah River Plant waste is summarized. Areas of development described are glass formulation and fabrication, and leaching and radiation effects.

13152 (K—2007) **Analysis of a gas absorption system with soluble carrier gas and volatile solvent.** Kanak, B.E. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jan 1980. Contract W-7405-ENG-26. 186p. Dep. NTIS, PC A09/MF A01.

The effects of column diameter, carrier gas coabsorption, and solvent vaporization on the performance of a packed gas absorption column are examined. The system investigated employs dichlorodifluoromethane as a solvent to remove krypton from a nitrogen stream and is characterized by substantial nitrogen coabsorption. Three columns with diameters of 2, 3, and 4 inches were constructed and packed with 34.5 inches of Goodloe packing. In addition to the more conventional data, the experimental evaluation of these columns included the use of a radioisotope and a gamma scanning technique which provided direct measurement of the columns' molar krypton profiles. A multicomponent gas absorption model was developed, based on the two-film mass transfer theory, that allows the fluxes of all species to interact. Verification of this model was achieved through comparison of the calculated results with experimental data. With the feed gas flow rate between 6 and 36 lb moles/hr-ft^2 and the solvent feed rate between 40 and 400 lb moles/hr-ft^2, column diameter was found to have no significant impact on the mass transfer efficiency of this system when carried out in columns with diameters of 2 inches or greater. The absorption of krypton was found to be enhanced and inhibited, respectively, by carrier gas coabsorption and solvent vaporization. An injector system to add gaseous solvent to the feed gas stream prior to its introduction into the packed bed was proposed to eliminate the detrimental effects of solvent vaporization.Using this injector to supersaturate the feed gas stream with solvent enhanced absorber performance in the same manner as carrier gas coabsorption.

13153 (PB—290865) **Cleaning up commingled uranium mill tailings: is federal assistance necessary.** (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 5 Feb 1979. 30p. NTIS, PC A03/MF A01.

Commingled uranium mill tailings are the sand-like radioactive wastes produced as a result of the processing of uranium for both Government and commercial purposes. This report primarily addresses the need for the Federal Government to assist active uranium mill owners in cleaning up commingled uranium mill tailings.

13154 (PB—295214) **A survey of the available methods of solidification for radioactive wastes.** Holcomb, W.F. (Office of Radiation Programs, Washington, DC (USA). Technology Assessment Div.). Nov 1978. 99p. NTIS PC A05/MF A01.

This report reviews the numerous solidification techniques and related matrix materials that are presently being offered or proposed for incorporating the radionuclides into an immobile materials. Both high- and low-level waste solidification processes are covered. Key features of the equipment used in individual solidification processes are described. At present the high-level waste solidification methods are being developed by the Government, while the low-level waste solidification methods are being developed commercially.

13155 (PB—296164) **Available methods of solidification for low-level radioactive wastes in the United States. Technical note.** Holcomb, W.F.; Goldberg, S.M. (Office of Radiation Programs, Washington, DC (USA). Technology Assessment Div.). Dec 1976. 49p. NTIS PC A03/MF A01.

This paper reviews the numerous solidification systems and related matrix materials that are presently being offered, or proposed, to the commercial nuclear power industry. Included, where possible, is the nature of how these materials and/or systems are affected by the physical, chemical, and radiolytic characteristics of the treated radioactive waste materials. Key features of the equipment used in individual solidification processes are discussed in order to clarify the relative utility of these processes for either power plant or fuel cycle application.

13156 (PNL—3050-2) **Research and development activities: high-level waste immobilization program. Quarterly progress report, April-June 1979.** McElroy, J.L.; Mendel, J.E.; Bonner, W.F.; Henry, M.H. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 48p. Dep. NTIS, PC A03/MF A01.

Test results are available on 21 out of a total of 65 glass compositions in a generic study of composition effects on waste glass properties such as Soxhlet leach rate, viscosity, electrical conductivity, and volatility. Preliminary results indicate the leaching behavior of a Cermet waste form prepared at ORNL is similar to that of waste glass and supercalcine. Scanning transmission electron microscopy has confirmed that supercalcine contains up to 10 vol% glassy phase and that small fractions of Cs, Sr, and rare earth reside in the glassy phase. Two long-term runs were completed in the ceramic melter coupled directly to the full-scale spray calciner. Two new ceramic melters were put into operation. A preliminary test in the small spray calciner indicates that coal, which is present in some Savannah River Plant wastes, is only partially decomposed during spray calcination. 15 figures, 11 tables.

13157 (RFP—2972) **Electrodecontamination using a basic electrolyte.** Childs, E.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1979. Contract EY-76-C-04-3533. 17p. (CONF-791103—72). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

A decontamination procedure for stainless steel is described that has the following advantages: rapid decontamination, one minute of time to reach nonretrievable level; easy to separate contamination by filtration; contamination is easy to recover in nitric acid; the electrolyte has an extended life - can be reused; and the waste generated from spent electrolyte is compatible with Rocky Flats waste processing.

13158 Pyrolysis model for an alpha waste incinerator prototype. Orloff, D.I. (duPont, Aiken, SC). *J. Energy;* 3: No. 2, 90-94(Mar-Apr 1979).

The development of a theoretical model of the pyrolysis stage of a Savnnah River Laboratory prototype alpha waste incinerator is discussed. pyrolysis rates for single-component porous bed of Teflon (registered trademark of Du Pont de Nemours and Co.) have been measured on a bench-scale furnace. Experimental pyrolysis rates compare favorably to the predictions of a quasisteady regression model. In addition, the pyrolysis rate is shown to be a weak function of the thermal diffusivity of the porous polymer bed. 13 refs.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 13130, 13138, 13139, 13150, 13580, 13897, 14022, 14243, 14444, 14449

13159 (LA—7931-PR) Studies of transuranic waste storage under conditions expected in the Waste Isolation Pilot Plant (WIPP). Interim summary report, October 1, 1977-June 15, 1979. Kosiewicz, S.T.; Barraclough, B.L.; Zerwekh, A. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 33p. Dep. NTIS, PC A03/MF A01.

The major focus of the program has been on the gas generation potential of organic wastes produced by radiolytic and thermal degradation under simulated WIPP storage conditions. The effects of TRU contamination level, temperature, waste type, pressure, and exposure time on radiolysis are presented. In addition, results from preliminary experiments on processed sludge dewatering are discussed. A summary is presented here of the results of a detailed study of all retrievably stored TRU wastes present at LASL before January 1, 1978. The data indicate a gross volume for the LASL inventory of 1610 m^3 with a total weight of nearly 1.24 x 10^6 kg (1240 metric tonnes). The dominant radionuclide contents of the waste are plutonium (primarily ^{238}Pu) and americium.

13160 (LA—8230-MS) Heat pipe cooling system for underground, radioactive waste storage tanks. Cooper, K.C.; Prenger, F.C. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 21p. Dep. NTIS, PC A02/MF A01.

An array of 37 heat pipes inserted through the central hole at the top of a radioactive waste storage tank will remove 100,000 Btu/h with a heat sink of 70°F atmospheric air. Heat transfer inside the tank to the heat pipe is by natural convection. Heat rejection to outside air utilizes a blower to force air past the heat pipe condenser. The heat pipe evaporator section is axially finned, and is constructed of stainless steel. The working fluid is ammonia. The finned pipes are individually shrouded and extend 35 ft down into the tank air space. The hot tank air enters the shroud at the top of the tank and flows downward as it is cooled, with the resulting increased density furnishing the pressure difference for circulation. The cooled air discharges at the center of the tank above the sludge surface, flows radially outward, and picks up heat from the radioactive sludge. At the tank wall the heated air rises and then flows inward to comple the cycle.

13161 (NUREG/CR—1037) Evaluation of isotope migration, land burial. Water chemistry at commercially operated low-level radioactive waste disposal sites. Progress report No. 10, July-September 1978. Colombo, P.; Weiss, A.J. (Brookhaven National Lab., Upton, NY (USA)). Sep 1979. Contract EY-76-C-02-0016. 44p. (BNL-NUREG—51083). Dep. NTIS, PC A03/MF A01.

Water samples were collected by anoxic procedures from trenches 2, 3, 4, 5, 8, and 9 at the West Valley, New York low-level radioactive waste disposal site. In-situ measurements of pH, Eh, specific conductance, and temperature were made. The results of inorganic, organic, and radiochemical analyses are reported. Acid-base titration curves exhibit the complex nature of these waters compared to local ground water. The methylene chloride extraction technique used to isolate acidic, neutral, and basic organic compounds from trench waters is described. Gas chromatograms and concentrations of individual compounds identified by GC/MS methods are shown. Cobalt-60, strontium-90, cesium-137, and plutonium-238, 239, 240 were found dissolved in all trench waters. Dissolved sodium-22 and cesium-134 were found in most trenches, whereas americium-241 was found dissolved only in trench 8.

13162 (ONWI—9(3)) Technical progress report, April 1-June 30, 1979. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1979. Contract EY-76-C-06-1830. 275p. Dep. NTIS, PC A12/MF A01.

Objective is to provide the technology and engineering design bases for a waste repository to isolate nuclear waste safely, with protection to the environment. This document reports progress on technology development, systems analysis, site characterization, licensing, and facility engineering. (DLC)

13163 (ORNL—5578) Effects of gaseous radioactive nuclides on the design and operation of repositories for spent LWR fuel in rock salt. Jenks, G.H. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 114p. Dep. NTIS, PC A06/MF A01.

Information relating to the identities and amounts of gaseous radionuclides present in spent LWR fuel and to their release from canistered spent fuel under plausible storage and disposal conditions was assembled, reviewed, and analyzed. Information was also reviewed and analyzed on several other subjects that relate to the integrity of the carbon steel canister in which the spent fuel is to be encapsulated and to the expected rates of transfer of gaseous radionuclides through crushed salt backfill within a disposal room in a reference repository in rock salt. The advantages and disadvantages were considered for several different canister-backfill materials, and recommendations were made regarding preferred materials. Other recommendations relate to encapsulation procedures and specifications and to needs for additional experimental studies. The objective of this work was to provide reference information, conclusions, and recommendations that could be used to establish design and operating conditions and procedures for a bedded salt repository for spent LWR fuel and that could also be used to help evaluate the safety of the repository. The results of this work will also generally apply to spent fuel repositories in domal salt. However, because the domal salt may have little or no brine inclusions within it, there may be little or no possibility that brine will migrate into open spaces around an emplaced canister. Addordingly, some of the concerns that result from the possible occurrence of brine migration in bedded salt may be of no importance in domal salt.

13164 (PNL—3070) Comparison of INTERA and WISAP consequence model application. Assessment of effectiveness of geologic isolation systems. Cole, C.R.; Bond, F.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 66p. Dep. NTIS, PC A04/MF A01.

The Waste Isolation Safety Assessment Program (WISAP) is being conducted to develop, for the Office of Nuclear Waste Isolation (ONWI), the methodology necessary to perform long-term safety assessments of deep geologic repositories. The Waste Isolation Pilot Plant (WIPP) program is developing a nuclear waste storage facility and is performing assessments of that site. WISAP and WIPP have similar, though independent, methodologies for assessing the consequences of a repository breach subsequent to closure. Intera Environmental Consultants are under contract to Sandia Laboratories to conduct the hydrologic and transport modeling for the WIPP Site Release Consequence Analysis (WIPP EIS/ER 1978). To provide a mutual benchmark check of the radionuclide and groundwater transport models of these two programs, ONWI has requested WISAP to perform a release consequence analysis based on the WIPP site, utilizing the same data and conceptual model which the WIPP program used for its environmental assessments. Therefore, only a portion of the WISAP methodology was used; specifically, only WISAP geotransport models were exercised. The other important parts of WISAP assessment methodology were not used, so that WISAP did not develop the scenario nor did WISAP interpret the field data to develop the conceptual model of the geohydrology of the WIPP site. The results of the comparative assessment are presented. Although the different models required slightly different input parameters, the results of the hydrologic simulations show a very close correspondence between the WISAP and WIPP predictions. This was as expected, since the various hydrologic codes available essentially utilize and solve the same basic flow equations. In addition, this report presents the results of the WISAP radionuclide transport model simulations. These results will provide the basis for comparison with WIPP results when these become available.

13165 (PNL-SA—7184) Methodology for assessing the long-term safety of radioactive waste storage in geologic formations. Brandstetter, A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1978. Contract EY-76-C-06-1830. 4p. (CONF-7809198—1). Dep. NTIS, PC A02/MF A01.

From Meeting on migration of radionuclides in crystalline rocks; Studsvik, Sweden (11 Sep 1978).

The development of the safety assessment methodology currently consists of four major tasks: release scenario analysis, waste release studies, release consequence analysis, and radionuclide sorption studies. Each of these tasks and plans for each are discussed. International cooperation on these tasks is urged. (DLC)

13166 (PNL-SA—7197) Workshop on Potentially Disruptive Phenomena for Nuclear Waste Repositories, July 27-28, 1977. Jacobson, J.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1977. Contract EY-76-C-06-1830. 37p. Dep. NTIS, PC A03/MF A01.

The workshop on Potentially Disruptive Phenomena for Nuclear Waste Repositories brought together experts in the geosciences to identify and evaluate potentially disruptive events and processes and to contribute ideas on how to extrapolate data from the past into the next one million years. The analysis is to be used to model a

repository in geologic media for long-term safety assessments of nuclear waste storage. The workshop included invited presentations on the following items: an overview of the Waste Isolation Safety Assessment Program (WISAP), simulation techniques, subjective probabilities and methodology of obtaining data, similar modeling efforts at Lawrence Livermore and Sandia Laboratories, and geologic processes or events.

13167 (RHO-BWI—79-100) **Basalt Waste Isolation Project. Annual report, fiscal year 1979.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1979. Contract EY-77-C-06-1030. 265p. Dep. NTIS, PC A12/MF A01.

This project is aimed at examining the feasibility and providing the technology to design and construct a radwaste repository in basalt formations beneath and within the Hanford Site. The project is divided into seven areas: systems integration, geosciences, hydrologic studies, engineered barriers, near-surface test facility, engineering testing, and repository engineering. This annual report summarizes key investigations in these seven areas. (DLC)

13168 (RHO-BWI-C—47) **Spring inventory of the Rattlesnake Hills.** Schwab, G.E.; Colpitts, R.M. Jr.; Schwab, D.A. (Summers (W.K.) and Associates, Inc., Socorro, NM (USA)). May 1979. Contract EY-77-C-06-1030. 207p. Dep. NTIS, PC A10/MF A01.

Springs and reported spring locations within about 182 square miles of the Rattlesnake Hills in Benton and Yakima Counties, Washington, were studied for this report. One hundred twenty-five discrete locations were visited. Water was tested at 74 locations. Of the remainder, 35 were dry, 7 were iced over, and 7 were damp (too little water to sample). Two cisterns were not sampled. Eighty-three water samples from 73 springs and 1 cistern were analyzed in the field. Temperature, specific conductance, and pH were measured at each sample site. Water from each of these sources was titrated to determine carbonate, bicarbonate, and carbon dioxide contents. Seventy-one sketch maps show sample sites plus 9 other locations. Profile sections accompany the sketches where such views are informative. Altitudes of visited locations range from 700 feet to 3360 feet. Altitudes of sampled springs range from 1150 feet to 3275 feet. Discharge rates within the study area range from seeps estimated at less than one-quarter gallon per minute to a multiple-spring stream measured at about 70 gallons per minute.

13169 (RHO-BWI-LD—22) **Site identification presentation: Basalt Waste Isolation Project.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1979. Contract EY-77-C-06-1030. 77p. Dep. NTIS, PC A05/MF A01.

The final step in the site identification process for the Basalt Waste Isolation Project is described. The candidate sites are identified. The site identification methodology is presented. The general objectives which must be met in selecting the final site are listed. Considerations used in the screening process are also listed. Summary tables of the guidelines used are included. (DMC)

13170 (RHO-CD—810) **Preliminary criteria for shallow-land storage/disposal of low-level radioactive solid waste in an arid environment.** Shord, A.L. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Sep 1979. Contract EY-77-C-06-1030. 81p. Dep. NTIS, PC A05/MF A01.

Preliminary criteria for shallow land storage/disposal of low level radioactive solid waste in an arid environment were developed. Criteria which address the establishment and operation of a storage/disposal facility for low-level radioactive solid wastes are discussed. These were developed from the following sources: (1) a literature review of solid waste burial; (2) a review of the regulations, standards, and codes pertinent to the burial of radioactive wastes; (3) on site experience; and (4) evaluation of existing burial grounds and practices. (DMC)

13171 (RHO-CD—896) **Review of classification of nine Hanford single-shell questionable integrity tanks.** Schulz, W.W. (comp.). (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Jan 1980. Contract EY-77-C-06-1030. 112p. Dep. NTIS, PC A06/MF A01.

Based upon this latest thorough review of the historical and current data base for Tanks 107-B, 110-B, 201-B, 101-C, 110-SX, 108-T, 111-T, 101-TY, and 112-U, Rockwell finds that Tanks 107-B, 201-B, 101-C, and 112-U should be relcassified as Confirmed Leakers. The volumes of liquid waste estimated to have leaked from these four tanks are: (1) Tank 107-B, 8,000 gallons (May 1968 to August 1969); (2) Tank 201-B, 1,200 gallons (April 1968 to June 1971); (3) Tank 101-C, 17,000 to 24,000 gallons (January 1968 to December 1969); and (4) Tank 112-U, 7,000 to 10,000 gallons (February 1969 to March 1970). Tanks 110-B, 110-SX, 108-T, 111-T, and 101-TY should continue to be classified as of Questionable Integrity.

13172 (SAND—79-0988C) **Radionuclide sorption studies on abyssal red clays.** Erickson, K.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-791112—48). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

The radionuclide sorption properties of a widely distributed abyssal red clay are being experimentally investigated using batch equilibration techniques. This paper summarizes sorption equilibrium data obtained when 0.68 N NaCl solutions containing either Tc, U, Pu, Am or Cm were contacted with samples of the red clay and also summarizes some initial results from experiments designed to determine the relative selectivity of the clay for various nuclides. Under mildly oxidizing conditions, the sorption equilibrium distribution coefficients for technetium were essentially zero. At solution-phase nuclide concentrations on the order of 10^{-6} M and less and at solution pH values of about 6.9, the distribution coefficients for plutonium were about 3×10^3 ml/gm and for uranium, americium, and curium were about 10^5 ml/gm or greater. However, at solution pH values of about 2.7, the distribution coefficients for each of the nuclides were greatly diminished. Initial experiments conducted in order to determine the relative selectivity of the clay for cesium, barium, and cerium, indicated that the silicate phases in the clay were selective for cesium over barium and cerium. These experiments also indicated that the hydrous oxide phases were selective for cerium over barium and for barium over cesium.

13173 (SAND—79-0989C) **Preliminary rate expressions for analysis of radionuclide migration resulting from fluid flow through jointed media.** Erickson, K.L. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 10p. (CONF-791112—47). Dep. NTIS, PC A02/MF A01.

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (26 Nov 1979).

A theoretical and experimental basis is being developed for analysis of radionuclide transport in jointed geologic media. Batch equilibration and rate experiments involving samples of Eleana argillite and tertiary silicic tuffs in contact with solutions containing Cs, Sr, or Pm indicated that most radionuclide sorption was associated with the surfaces of very small intergranular regions and that the rate of sorption was controlled by diffusion of the nuclides into such regions. Based on these experimental results, the continuity equations for radionuclides in the mobile and immobile phases were reduced to a model analogous to Rosen's equations for packed beds and were solved similarly. Using the model and experimental data, limited radionuclide transport analyses were made which indicated that important parameters controlling transport include the intergranular porosity and nuclide penetration depth, fracture plate spacing and length, fluid velocity and sorption distribution coefficient. Many of these parameters represent physical quantities or processes which can be quantified in the laboratory. However, fluid velocities and fracture plate spacings and lengths must be obtained from the field, and methods must be developed to establish reliable bounds for such field-determined parameters.

13174 (SAND—79-2141) **Borehole Plugging Program. Status report, October 1, 1978-September 30, 1979.** Christensen, C.L.; Cook, C.W.; Gulick, C.W. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 24p. Dep. NTIS, PC A02/MF A01.

This program is in support of the Waste Isolation Pilot Plant (WIPP) proposed for southeastern New Mexico. Current-year activities cover management, materials, instrumentation, and field tests. Proposed FY 80 activities are also outlined. (DLC)

13175 (UCRL—15163) **Survey of near-field flow calculations for nuclear waste repositories NMA L21.** Wilson, R.N.; Holland, D.H. (New Millennium Associates, Santa Barbara, CA (USA)). Nov 1979. Contract W-7405-ENG-48. 39p. Dep. NTIS, PC A03/MF A01.

A survey of methods and codes which describe the flow of groundwater and the migration of radioactive waste in and about nuclear repositories was performed. A number of laboratories engaged in studies of waste migration and groundwater flow were visited in order to discuss the general problem and obtain reports of work being performed. The results of this survey are discussed. (DMC)

13176 (Y/OWI/TM—37) **Areal thermal loading recommendations for nuclear waste repositories in salt.** Russell, J.E. (Union Carbide Corp., Oak Ridge, TN (USA). Office of Waste Isolation). Jun 1979. Contract W-7405-ENG-26. 50p. Dep. NTIS, PC A03/MF A01.

This document gives a wider understanding of the history of the recommended thermal loadings in salt for both high-level waste (HLW) from fresh UO_2-fueled, light-water reactors (LWR) with no recycle and spent unreprocessed fuel (SURF) from LWRs. Aspects of the current recommendations that need further study are identified. Finally, an interim set of design thermal-loading recommendations are given that have a common rationale of satisfying performance limits within our current state of knowledge. These recommendations are made on a generic rather than a site-specific basis. 11 figures, 5 tables.

13177 Technical note: 1957-1958 Soviet nuclear accident in the Urals. Trabalka, J.R. (Oak Ridge National Lab., TN); Auerbach, S.I.; Eyman, L.D. *Nucl. Saf.;* **21**: No. 1, 94-99(Jan 1980).

The available but limited information concerning the major airborne release of fission wastes in the Soviet Union in 1957-58 is discussed. A theory that the release was the result of unusual localized fallout from a Soviet atmospheric weapons test is rejected. An earlier article by Stratton, et. al. is criticized. The authors suggest that evidence points to an accident involving the high-level radioactive waste storage of plutonium.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 13149, 13153, 13163, 13175, 13177, 13966, 14244

13178 (DOE/EV—0005/18) **Formerly utilized MED/AEC sites remedial action program: radiological survey of the former Virginia-Carolina Chemical Corporation Uranium Recovery Pilot Plant, Nichols, Florida. Final report.** Haywood, F.F.; Doane, R.W.; Goldsmith, W.A.; Shinpaugh, W.H.; Crawford, D.J.; Fox, W.F.; Leggett, R.W.; Stone, D.R. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 92p. Dep. NTIS, PC A05/MF A01.

The results of a radiological survey conducted at the site of a former uranium recovery pilot plant operated by the Virginia-Carolina Chemical Corporation is presented. All that remains of this operation is a concrete pad situated within the boundary of a phosphate products plant now operated by Conserv, Inc., at the Nichols, Florida site. The survey included measurements designed to characterize the residual radioactivity in the vicinity of this pilot plant and to compare the quantities with federal guidelines for the release of decontaminated property for unrestricted use. The results of this survey indicate that only small quantities of radioactivity exist above normal background levels for that area. Some soil contamination was found in the vicinity of a concrete pad on which the pilot plant stood. Much of this contamination was due to ^{226}Ra and ^{238}U. Some beta-gamma dose rates in excess of applicable guidelines were observed in this same area. External gamma-ray exposure rates at 1 m above the ground range from 20 to 100 μR/hr. None of the direct measurements of alpha contamination were above guideline levels.

13179 (NTIS/PS—79/0139) **Uranium mining and milling environmental studies (citations from the NTIS data base). Report for 1964-January 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 211p. NTIS, PC N01/MF N01.

Pollution, public and occupational health, and waste management associated with uranium ore recovery and processing are cited. The monitoring and control of contamination in air and effluents in the mining vicinities are discussed in this collection of Federally-funded research. (This updated bibliography contains 203 abstracts, 78 of which are new entries to the previous edition.)

13180 (NTIS/PS—79/0140) **Uranium mining and milling environmental studies (citations from the Engineering Index data base). Report for 1970-January 1979.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Mar 1979. 90p. NTIS, PC N01/MF N01.

Worldwide research is cited on uranium mining waste management and effluent control. Studies on mining practices, radon monitoring, health hazards, and land reclamation are covered. Government policies and regulations concerning present and long term waste handling are included. (This updated bibliography contains 86 abstracts, 15 of which are new entries to the previous edition.)

13181 (PNL—2286) **Descriptions of reference LWR facilities for analysis of nuclear fuel cycles.** Schneider, K.J.; Kabele, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 528p. Dep. NTIS, PC A28/MF A01.

To contribute to the Department of Energy's identification of needs for improved environmental controls in nuclear fuel cycles, a study was made of a light water reactor system. A reference LWR fuel cycle was defined, and each step in this cycle was characterized by facility description and mainline and effluent treatment process performance. The reference fuel cycle uses fresh uranium in light water reactors. Final treatment and ultimate disposition of waste from the fuel cycle steps were not included, and the waste is assumed to be disposed of by approved but currently undefined means. The characterization of the reference fuel cycle system is intended as basic information for further evaluation of alternative effluent control systems.

13182 Measurement of radon diffusion and exhalation from uranium mill tailings piles. Silker, W.B.; Wogman, N.A.; Thomas, C.W.; Carr, D.B.; Heasler, P.C. (Pac Northwest Lab, Richland, Wash). *Environ. Sci. Technol.;* **13**: No. 8, 962-964(Aug 1979).

The concentrations of ;sup 226;Ra and ;sup 222;Rn (;sup 214;Pb) were measured as a function of depth within a uranium mill tailings pile by in situ ;gamma;-ray spectrometry. Radon diffusion and exhalation rates were determined from the concentration gradients by employing an integral solution of the diffusion equation that accomodates a nonuniform depth distribution of the parent radium. Radon diffusion coefficients of 0.0002 and 0.0017 cm;sup 2;s;sup -1; and exhalation rates of 60--275 atoms cm;sup -2;s;sup -1; were determined for two locations with differing soil moisture content. 12 refs.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 13131, 13142, 13149, 13164, 13165, 13166, 13177

REGULATIONS

REFER ALSO TO CITATION(S) 13126

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 13128, 13953, 14128

13183 (CONF-791117—20) **In-situ verification techniques for fast critical assembly cores.** Brumbach, S.B.; Amundson, P.I.; Roche, C.T. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 34p. NTIS, PC A03/MF A01.

From ANS topical conference; Kiawah Island, SC, USA (26 Nov 1979).

Active and passive autoradiographic techniques were used to obtain piece counts of fuel plates in fast critical assembly drawers and to verify the assembly loading pattern. Active autoradiography using prompt-fission and fission-product radiation was more successful with uranium fuel while passive autoradiography was more successful with plutonium fuel. A source multiplication technique was used to measure changes in reactivity when small quantities (2-2.5 kg) of fissile material were removed from a subcritical reference core of the Zero Power Plutonium Reactor. Efforts to compensate for unsuccessful. Some compensation was achieved by replacing U-238 with polyethylene. The sensitivity for detection of partially compensated fuel removed from minimum worth regions was approximately 2.5 kg (fissile) for a core containing 2600 kg (fissile). Substitution of polyethylene was detected with a spectral index which was the ratio of the rate of the In-115 (n,γ) reaction to the rate of the In-115 (n,n') reaction. This spectral index was sensitive to the presence of an 0.64-cm-thick, 5.08-cm-high polyethylene column 10-15 cm away from the indium foil. The reactivity worth of Pu-239 was also obtained as a function of location in the reactor core with the use of an inverse kinetics technique. Reactivity worths for Pu-239 varied from a maximum of 58.67 Ih/kg near the core center to a minimum of 14.86 Ih/kg at the core edge.

13184 (ENICO—1025) **Instrument installation design criteria safeguards test and evaluation system.** Wagner, E.P. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 15 Aug 1979. Contract AC07-79ID01675. 73p. Dep. NTIS, PC A04/MF A01.

Improved safeguards can be achieved by installing the latest sensor and instrument technology to allow process and nuclear material monitoring and data analysis with a high-speed data processing system. The design concept of such a system is presented. A primary objective of the safeguards development program is installation of a test and evaluation system in the Idaho Chemical Processing Plant at INEL for plant sensor and instrument operational testing. The system will be assembled over the next 20 months for test and evaluation support starting in FY 1980. Two parallel efforts are initiating the system development. The first is the data acquisition and processing system design by a joint INEL effort with EG and G and ENICO personnel. The second is a detailed ICPP installation design. The ICPP installation is emphasized for the purpose of providing background for the detailed installation design.

13185 (LA—8125-PR) **Nuclear safeguards research and development. Progress report, July-September 1979.** Gardner, S.D. (ed.). (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 47p. Dep. NTIS, PC A03/MF A01.

This report presents the status of the Nuclear Safeguards Research and Development program pursued by the Los Alamos Scientific Laboratory Safeguards Groups Q-1, Q-2, Q-3, Q-4, and Q-5. Topics covered include nondestructive assay technology development and applications, international safeguards, perimeter safeguards and surveillance, concepts and subsystems development (e.g., DYMAC program), integrated safeguards systems, training courses, and technology transfer.

13186 (LA-UR—79-2607) **Intelligent data-acquisition instrumentation for special nuclear material assay data analysis.** Ethridge, C.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 14p. (CONF-800306—2). Dep. NTIS, PC A02/MF A01.

From International IECI conference; Philadelphia, PA, USA (17 Mar 1980).

The Detection, Surveillance, Verification, and Recovery Group of the Los Alamos Scientific Laboratory Energy Division/ Nuclear Safeguards Programs is now utilizing intelligent data-acquisition instrumentation for assay data analysis of special nuclear material. The data acquisition and analysis are enabled by the incorporation of a number-crunching microprocessor sequenced by a single component microcomputer. Microcomputer firmware establishes the capability for processing the computation of several selected functions and also the ability of instrumentation self-diagnostics.

13187 (NUREG/CR—1258(Vol.1)) **Inspection methods for physical protection project. Quarterly report, September-November 1979.** Bradley, R.T.; Bowden, D.D.; Olson, A.W.; Rogue, F.; Savage, J.W.; Scala, S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Dec 1979. Contract W-7405-ENG-48. 17p. (UCID—18123-79-3). Dep. NTIS, PC A02/MF A01.

Physical protection inspections were observed at Millstone, Apollo Facility, North Anna, St. Lucie, and Humboldt Bay. Power reactor inspection modules were produced. PP inspector training methods were examined. Results of the physical protection equipment survey at power and research reactors are tabulated.

13188 (SAND—79-2242/1) **Fixed site neutralization model programmer's manual. Volume 1.** Engi, D.; Chapman, L.; Judnick, W.; Blum, R.; Broegler, L.; Lenz, J.; Weinthraub, A.; Ballard, D. (Sandia Labs., Albuquerque, NM (USA)). Dec 1979. Contract EY-76-C-04-0789. 275p. Dep. NTIS, PC A12/MF A01.

The Fixed Site Neutralization Model (FSNM) is a stochastic, time-stepped simulation of an engagement process whereby an adversary force attempts to steal or sabotage sensitive (e.g., nuclear) materials being guarded by a security force on a fixed site and a response force that is off-site. FSNM will assist regulatory bodies of the US Government in evaluating fixed site physical protection systems at various installations in a variety of scenarios. Most data input to the Fixed Site Neutralization Model are in binary form. The user's data are transformed into binary form by two supporting modules, the Data Preprocessor (DPP) and the Plex Preprocessor (PPP). Both preprocessors and the FSNM itself are written in FORTRAN. This volume of the program maintenance program contains: introduction, logic descriptions, PLEX data structure, PLEX records, dictionaries, and error conditions and comments.

13189 (SAND—79-7037) **Development of an automated stress/ duress detection system. Phase II: field studies, Albuquerque Police Department.** Tuttle, W.C.; Davis, J.G. (Lovelace Center for the Health Sciences, Albuquerque, NM (USA). Clinical Research Div.). Dec 1979. Contract EY-76-C-04-0789. 27p. Dep. NTIS, PC A03/MF A01.

This study has shown that remote analysis of heart rate has potential as an effective means for automatic detection of stress in guards. The analysis of the data suggests that a heart rate greater than either CHR + 20% (as established in the exercise test) or 150 bpm is the best criterion for initial establishment of alarm criteria. This algorithm may be refined greatly through application of more extensive computer analysis.

13190 (UCRL—15144) **Insider threat to secure facilities: data analysis.** (Heineke (J.M.) and Associates, Livermore, CA (USA)). 7 Dec 1979. Contract W-7405-ENG-48. 86p. Dep. NTIS, PC A05/MF A01.

This report is the culmination of a project in which data from several industries confronting internal security threats were collected and analyzed. The industries and threats involved are deemed to be analogous in one or more respects to potential threats confronting decision makers in the nuclear industry. The analog internal threats consist of bank frauds and embezzlements over $10,000, computer crimes of various types and insider drug thefts from drug manufactures and distributors. These data have been subjected to careful analysis utilizing both descriptive and formal statistical techniques. A number of findings are quite suggestive as to the general nature of the internal threat and are discussed and interpreted in terms of thenuclear industry analogy.

13191 **Computer-based in-plant nondestructive assay instrumentation for the measurement of special nuclear materials.** Canada, T.R.; Parker, J.L.; Russo, P.A. (Los Alamos Scientific Lab., New Mexico). pp 746-766 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

This paper reviews three instruments that combine the techniques of gamma-ray spectroscopy with the technology of minicomputers. The resulting NDA systems represent a spectrum of time-saving and accurate measurement capabilities available off line, at line, or in line to plant personnel for the safeguarding and control of special nuclear materials. 11 figures.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 13675

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

REFER ALSO TO CITATION(S) 14571

13192 (UCRL—83390) **Fusion target analysis by quantitative scanning electron microscopy.** Ward, C.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1979. Contract W-7405-ENG-48. 5p. (CONF-800208—9). Dep. NTIS, PC A02/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

Recent developments in computer based systems for quantitative x-ray microanalysis, 4 Pi surface examination, Auger electron spectroscopy and Backscattered Microtopography measurement have extended the Scanning Electron Microscope's applications in ICF target development and production.

13193 (UCRL—83392) **Rapid interferometric sorting of fusion targets.** Reel, G.T.; Woerner, R.L.; Willenborg, D.L.; Weinstein, B.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Sep 1979. Contract W-7405-ENG-48. 5p. (CONF-800208—8). Dep. NTIS, PC A02/MF A01.

From Tropical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

A Mach-Zehnder interference microscope was automated which quickly characterizes and sorts transparent microspheres. It takes only 12 seconds to measure a 3 micron thick glass microsphere.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 13803

RADIATION SOURCES

13194 (PNL—3165) **Collapse of experimental capsules under external pressure.** Simonen, F.A.; Shippell, R.J. Jr. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 38p. Dep. NTIS, PC A03/MF A01.

Stress analyses and developmental tests of capsules fabricated from thick-walled tubing were performed for an external pressure design condition. In the design procedure no credit was taken for the expected margin in pressure between yielding of the capsule wall and catastrophic collapse or flattening. In tests of AISI-1018 low carbon steel capsules, a significant margin was seen between yield and collapse pressure. However, the experimental yield pressures were significantly below predictions, essentially eliminating the safety margin present in the conservative design approach. The differences between predictions and test results are attributed to deficiencies in the plasticity theories commonly in use for engineering stress analyses. The results of this study show that the von Mises yield condition does not accurately describe the yield behavior of the AISI-1018 steel tubing material for the triaxial stress conditions of interest. Finite element stress analyses successfully predicted the transition between uniform inward plastic deformation and ovalization that leads to catastrophic collapse. After adjustments to correct for the unexpected yield behavior of the tube material, the predicted pressure-deflection trends were found to follow the experimental data.

DESIGN AND FABRICATION

REFER ALSO TO CITATION(S) 14283, 14284, 14292

ISOTOPIC POWER SUPPLIES

REFER ALSO TO CITATION(S) 13722, 14224

DESIGN AND FABRICATION

13195 (DPST—79-128-1/2) **^{238}Pu fuel form processes. Bimonthly report, January-February 1979.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 10 Dec 1979. Contract EY-76-C-09-0001. 44p. Dep. NTIS, PC A03/MF A01.

Microstructural studies of small-scale GPHS fuel pellets indicate that a reduction in the sintering temperature of the high-fired shards from 1600°C to 1400°C had (1) only small effects on microstructure and (2) apparently no effect on dimensional stability or fracture resistance of the pellets. Small $^{238}PuO_2$ pellets hot pressed to different densities cracked during reoxidation in air at both low and high temperatures when microstructural densities exceeded 84 to 85% theoretical density. A new furnace rack-tray assembly made of ZGS Pt-10% Rh was designed for the plutonium fuel fabrication sintering furnace to provide capability for sintering high-fired (1600°C) shards for the production of General-Purpose Heat Source fuel pellets. The first unreduced hot-pressed pellets of PuO_2 have been fabricated by using an alumina die liner in a graphite diesusceptor. The pellets were integral and uncracked after heat treatment in oxygen.

13196 (DPST—79-128-3/4) **^{238}Pu fuel form processes bimonthly report, March-April, 1979.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Mar 1979. Contract EY-76-C-09-0001. 47p. Dep. NTIS, PC A03/MF A01.

Progress in the Savannah River Laboratory ^{238}Pu Fuel Form Program is reported. Goals of the Savannah River Laboratory (SRL) program are to provide technical support for the transfer of DANSP ^{238}Pu fuel form fabrication operations from Mound Laboratory to new facilities at the Savannah River Plant (SRP), to provide the technical basis for ^{238}Pu scrap recovery at SRP, and to assist in sustaining plant operations. The program includes: demonstration and adaptation of processes and techniques, developed by the Los Alamos Scientific Laboratory (LASL) and Monsanto Research Corporation (MRC), for production at SRP. (Information from the demonstration will provide the technical data for technical standards and operating procedures.); technical support to assist plant startup of new processes and to ensure continuation of safe and efficient production of high-quality heat-source fuel; and technical assistance after startup to accomodate changes in product and product specifications, to assist user agencies in improving product performance, to assist SRP in making process improvements that increase process efficiency and safety and product reliability, and to adapt plant facilities for new products.

13197 (MLM—2683) **Moisture content of PuO_2 fuel used for the milliwatt generator heat source.** Zanotelli, W.A. (Mound Facility, Miamisburg, OH (USA)). 31 Jan 1980. Contract EY-76-C-04-0053. 12p. Dep. NTIS, PC A02/MF A01.

The determination of the moisture content of ^{238}Pu dioxide fuel for use in Milliwatt Generator heat sources was studied in an attempt to more clearly define the production fuel preloading procedures. The study indicated that water was not present or being adsorbed at various steps of the process (or during storage) that could lead to compatibility problems during pretreatment or long-term storage. The moisture content of the plutonium dioxide was analyzed by a commercial moisture analyzer. The moisture content at all steps of the process including storage averaged from 0.002% to 0.005%. The moisture content of the plutonium dioxide exposed to moist atmosphere for 7 days was 0.001%. These values indicated that no significant amount of moisture was adsorbed by the plutonium dioxide fuel charges. The only significant moisture content found was an average of 3.47%, after self-calcination. This was expected since no additional steps, other than self-heating of the fuel, are taken to remove the water.

HYDROGEN

PRODUCTION

13198 (N—79-26240) **Comparison of different techniques for producing hydrogen: production costs analysis comparison des procedes de production d'hydrogene - elements d'appreciation des coutes de production.** Portas, J.Y. (Electricite de France, 78 - Chatou). Dec 1976. 79p. NTIS, PC A05/MF A01.

A multivariable economic analysis of different techniques available, or under study, for the production of hydrogen as an alternative energy source is given. Present and projected costs of hydrogen production by electrolysis are considered. Alternative techniques such as vapor reconstitution or partial oxidation of hydrocarbons, coal gasification, and thermochemistry are also evaluated. Finally, an in depth cost analysis of methods for obtaining hydrogen by electrolysis is made in order to provide a basis for comparison with other techniques.

13199 (NTIS/PS—79/0773) **Hydrogen production (citations from the International Aerospace Abstracts data base). Report for 1977-July 1979.** Zollars, G.F. (New Mexico Univ., Albuquerque (USA). Technology Application Center). Aug 1979. 45p. NTIS PCN01/MF N01.

This bibliography cites articles from the international literature concerning hydrogen production. Techniques examined include solar energy conversion, coal gasification, thermal dissociation, and water electrolysis. (Contains 169 citations)

ELECTROLYSIS

13200 (BNL—27163) **Oxygen and hydrogen evolution reaction on oriented single crystals of ruthenium dioxide.** Berger, L.I.; Pollak, F.H.; Canivez, Y.; O'Grady, W. (Brooklyn Coll., NY (USA). Dept. of Physics; Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 4p. (CONF-791127—8). Dep. NTIS, PC A02/MF A01.

From DOE chemical energy storage and hydrogen energy systems contracts review meeting; Reston, VA, USA (12 Nov 1979).

A novel design for water electrolysis using a solid polymer electrolyte is being developed by General Electric. Ruthenium is one of the best electrocatalysts for the oxygen evolution reaction. There are problems connected with the significant loss in electrocatalytic activity with time. This performance degradation is presumably due to the gradual formation of an RuO_2 film. We have performed electrochemical measurements on [100], [110] and [111] oriented single crystals of RuO_2 in order to elucidate the mechanism of the electrocatalytic process. Large single crystals were grown by the vapor transport method. Our investigation has revealed several interesting differences for the various orientations. This study indicates that RuO_3 may be an important intermediate species prior to oxygen evolution and that the formation of the RuO_3 is the rate limiting process. Similar results were previously obtained for IrO_2.

13201 (N—79-26335) **Pressurized water electrolysis test circuit: initial operating results boucle d'essais d'electrolyse de l'eau sous pression: premiers resultats d'exploitation.** Damien, A.; Barre, J.C. (Electricite de France, 75 - Paris). Feb 1977. 16p. NTIS, PC A02/MF A01.

Different components making up a pressurized circuit for water electrolysis were tested at 20 bars, at temperatures of 60C and 100C, in order to determine voltage to current density characteristics of independent electrolytic cells equipped with either activated or nonactivated electrodes. Problems encountered with the experimental setup are described and solutions are discussed. Results justify the construction of a pressurized circuit operating at 180 C, having horizontal seperators, a 12V-1500 amp power supply, and encompassing eight cells with the possibility of adding others if necessary.

13202 (N—79-26532) **The use of fuel cell ion exchange membranes in electrolytic cells les membranes echangeuses d'ions des piles a combustibles.** Damien, A.; Sohm, J.C. (Electricite de France, 75 - Paris). Jun 1977. 24p. NTIS, PC A02/MF A01.

Ion exchange membranes, previously used in fuel cells, were studied in order to examine their application to water electrolysis. State-of-the-art is reviewed from the bibliography, comparing this process with a classic one. Results show that only the cationic membranes are adequate for electrolytic cell use, being sufficiently resistant to heat and oxidation.

THERMOCHEMICAL PROCESSES

REFER ALSO TO CITATION(S) 13368

COAL GASIFICATION

REFER ALSO TO CITATION(S) 12933, 12963

PARTIAL OXIDATION PROCESSES

REFER ALSO TO CITATION(S) 12958

STORAGE

CHEMISORPTION

13203 (NTIS/PS—79/0772) **Hydrogen storage as a hydride (citations from the International Aerospace Abstracts data base). Report for 1975-July 1979.** Zollars, G.F. (New Mexico Univ., Albuquerque

(USA). Technology Application Center). Aug 1979. 29p. NTIS PCN01/MF N01.

These citations to articles from the international literature concern the storage of hydrogen in various metal hydrides. Binary and intermetallic hydrides are considered. Specific alloys discussed are iron-titanium, lanthanum-nickel, magnesium-copper, and magnesium-nickel among others. (Contains 97 citations)

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 13872

OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 13584

HYDROCARBON FUELS

13204 (GRI—78/0027) **Assessing the benefits of the Gas Research Institute's research and development programs: executive summary.** Kinderman, E.M.; Kohan, S.M.; Coene, G.T. (SRI International, Menlo Park, CA (USA)). Mar 1978. 24p. NTIS.

This study evaluated the potential benefits to the gas industry's ratepayers of proposed gas supply research and development (R and D) activities of the Gas Research Institute. Ratepayer benefits were estimated for several possible future energy demand scenarios and for several levels of gas price for each advanced technology (SNG, etc.). Results show that significant ratepayer benefits would result from the Gas Research Institute's (GRI) proposed gas supply R and D activities.

PREPARATION

REFER ALSO TO CITATION(S) 13882

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 12933, 12962

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 13217, 13218, 13295, 13298, 13299, 13369, 13504

13205 (CONF-790987—, pp 38p, Paper 4) **Survey: status of biomass waste and residue fuels for use in directly fired heat engines.** Birkeland, J.W. (Dept. of Energy, Washington, DC). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The Federal Government has reemphasized a major commitment to the development and commercialization of solar technologies. In his June 20, 1979 address on energy issues, President Carter established that a goal of 20% (18 quads per year) of the nation's energy requirement is to be supplied by renewable resources by the year 2000. A significant proportion of the 20% solar goal will have to be supplied through utilization of the biomass resource. The DOE Domestic Policy Review Committee (DPR) (1) has estimated that direct combustion of the wood resource could have a significant input, displacing up to 5.4 quads of energy. A value of 4.4 quads/y was selected by the DPR and is the goal of the Wood Commercialization Program initiated in FY 80 within the DOE Office of the Assistant Secretary for Conservation and Solar Applications (CS). As stated in DOE program documents, a successful wood program requires the accelerated use of wood combustion technologies and development of more efficient and new types of systems. The results could be: 132,000 to 264,000 permanent new jobs; $10.5 B improvement in the US balance of payments - under the DPR estimate of $32/bbl; lower emissions in many localized situations; and improved commercial tree growth through provision of markets for thinnings, cull trees, and noncommercial species. The DOE Wood Commercialization Program is presently specific to the wood resource but will naturally evolve to include the agricultural resource. This paper is a survey of the status of biomass waste and residue fuels for use in directly fired heat engines and concentrates on the crop and agricultural resource sector. The paper describes the resource sector and the utilization sector and concludes that there is a significant potential for penetration of heat engines into this energy conversion market place.

13206 (CONF-790987—, pp 41p, Paper 7) **Gas turbine demonstration of pyrolysis derived fuels.** Jasas, G. (Teledyne CAE Turbine Engines, Toledo, OH). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The objective of this contract is to conduct engineering analysis and tests which demonstrate the feasibility of utilizing pyrolytic oil and char as a fuel for a direct combustion turbine engine. The anticipated results include: (a) design, fabrication and procurement of slinger combustor rig to be used in combustion tests and evaluations; (b) characterization of pyrolysis-derived fuels in terms of its properties and constituents; (c) pyrolytic fuel combustion data derived from full scale combustor rig and gas turbine engine; and (d) data base for commercialization feasibility evaluations.

13207 (CONF-790987—, pp 23p, Paper 8) **Synthetic fuels from a mobile pyrolizer.** Mosley, R.H. (California State Solid Waste Management Board, Sacramento). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The design and building of a mobile fluidized bed pyrolysis system is described. Demonstrations at cotton gins and rice mills are discussed. The results were: solution to a significant air pollution problem; new fuel source; utilization of a renewable resource; potential new industry with associated new jobs; and an alternative waste disposal system. (DC)

13208 (COO—4388-7) **Liquid fuels production from biomass. Progress report No. 7, January 1-March 31, 1979.** Sanderson, J.E.; Garcia-Martinez, D.V.; George, G.S.; Dillon, J.J.; Wise, D.L. (Dynatech R/D Co., Cambridge, MA (USA)). 1979. Contract EG-77-C-02-4388. 86p. Dep. NTIS, PC A05/MF A01.

The current program to convert biomass into liquid hydrocarbon fuels is an extension of the previous program to ferment marine algae to acetic acid. In that study, it was found that marine algae could be converted to higher aliphatic organic acids and that these acids could be readily removed from the fermentation broth by membrane or liquid-liquid extraction. It was then proposed to convert these higher organic acids to aliphatic hydrocarbons via Kolbe Electrolysis, which may be used as a diesel fuel. The specific goals for the current program are: (1) establish conditions under which substrates other than marine algae may be converted in good yield to organic acids. The primary task in this regard is methane suppression; (2) modify the current 300 liter fixed packed bed batch fermenter to operate in a continuous mode; (3) change from membrane extraction of organic acids to liquid-liquid extraction; (4) optimize the energy balance of the electrolytic oxidation process. The primary task in this regard is to reduce the working potential required for the electrolysis while maintaining an adequate current density; (5) scale the entire process up to match the ouput of the 300 liter fermenter. The accomplishments in this program are on schedule. Experimental results have shown that the electrolysis of organic acids produced by fermentation to liquid hydrocarbon fuels is already operating with a favorable energy balance of 6/1 based on the applied potential and over 10/1 based on the working potential. 2-Bromoethanesulfonic acid, a coenzyme M analogue, has been shown to be an effective methane suppressor, and the program is being rapidly expanded to include biomass substrates other than marine algae. In addition, considerable effort has been directed toward refining the process design and economic analysis presented previously.

13209 (COO—4755-T1) **Economic and kinetic studies of the production of chemicals and farm energy by fermentation of biomass.** Gaddy, J.L. (Missouri Univ., Rolla (USA)). 1979. Contract EW-78-A-02-4755. 8p. Dep. NTIS, PC A02/MF A01.

The farm energy system has been constructed in Drury, Missouri. The purpose of this unit is to demonstrate the feasibility of producing energy for farms (heat and electricity) from methane produced by anaerobic digestion of crop residues and other crop materials. The acid hydrolysis pre-treatment of corn stover studies utilize a two stage sulfuric acid contact. In the first stage, dilute sulfuric acid is used to hydrolyze the pentosan fraction of ground biomass. The second stage uses concentrated sulfuric acid for hexosan hydrolysis. The use of the two steps give high yields, possible with concentrated acid, without the problems of pentose decomposition.

13210 (DOE/ET/20638—T1) **Anaerobic fermentation of livestock and crop residues. Quarterly progress report, July-September, 1979.** Hashimoto, A.G.; Chen, Y.R. (Science and Education Administration, Clay Center, NE (USA). Meat Animal Research Center). 1979. Contract AI01-79ET20638. 5p. Dep. NTIS, PC A02/MF A01.

The overall objective of this project is to evaluate the technical and economic feasibility of the anaerobic fermentation process to recover methane and high protein biomass from beef cattle and crop residues. The specific objectives of interest to the Department of Energy are: (a) to develop design criteria for optimum production of methane from anaerobic digestion of beef cattle qnd crop residue;

and (b) to determine the capital and operating costs, and energy, manpower and safety requirements for anaerobic fermentation systems associated with livestock operations. This report summarizes the operation of the pilot-scale fermentor during the reporting period.

13211 (DSE—3891-T2) **Heat treatment of organics for increasing anaerobic biodegradability. Quarterly progress report, July 1, 1979-September 30, 1979.** Stuckey, D.; Colberg, P.J.; Baugh, K.; Young, L.Y.; McCarty, P.L. (Stanford Univ., CA (USA). Dept. of Civil Engineering). 1979. Contract EG-77-X-01-3891. 18p. Dep. NTIS, PC A02/MF A01.

The objective of this study is to evaluate thermochemical pretreatment as a method for increasing the anaerobic biodegradability of organic materials so that they can be more completely fermented to methane gas, a potential source of fuel. The current study has four specific phases: (1) biological conversion of lignocellulose to methane, (2) biodegradation of lignin and lignin fractions, (3) pretreatment of nitrogenous organics for increasing biodegradability, (4) biodegradation of lignin aromatic compounds, and (5) biochemical methane potential and toxicity testing. Results are reported for phases one, two, and three. No new information is available for phases four and five at this time.

13212 (DSE—4015-T1) **Fuel gas from an environmental feedlot. Progress report, May 1-September 30, 1979.** (Hamilton Standard, Windsor Locks, CT (USA)). 1979. Contract EG-77-C-01-4015. 15p. Dep. NTIS, PC A02/MF A01.

Since May, successful fermentations were established at both 122°F and 131°F. Due to lower than anticipated manure quantities, a result of low feedlot cattle population, the contents of the two fermentors were blended together in one tank which is presently operating at 131°F. It is evident from the data that an adaptation time of a minimum of 30 days is necessary before the onset of significant fermentation. Specific methane production of more than 3.5 cubic feet per pound of volatile solids loaded has been attained. The present limitation to increased gas production and the restart of the second fermentor is the lack of cattle in the feedlot. This situation is expected to improve slowly over the next several months.

13213 (GRI—78/0003) **Overview of research and development activities in biomass.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Aug 1978. 45p. NTIS.

The purpose of this report is to provide the Gas Research Institute (GRI) with an overview of research activities related to the production of synthetic natural gas (SNG) from biomass sources. While covering a variety of research activities related to biomass production and conversion, the report focuses upon the production of methane from biomass. The overview is intended to assist GRI in planning its research program, and to provide an information base for ensuring that its programs are coordinated with activities of industry and government. An overview of the importance of biomass research and development is presented. A review of current research activity being funded by industry, universities and similar organizations, government, and GRI is included.

13214 (PB—292113) **Source emission tests at the Baltimore demonstration pyrolysis facility. Final report.** Haslbeck, J.L.; McCoy, B.C. (TRW Environmental Engineering Div., Vienna, VA (USA)). Dec 1978. Contract EPA-68-01-2988. 87p. NTIS, PC A05/MF A01.

TRW was retained by EPA/IERL Cincinnati in May of 1976 to conduct source emission tests at a solid waste treatment plant in Baltimore, Maryland. The plant is designed to recover low-grade fossil fuel from non-toxic solid waste by the use of a process known as pyrolysis. When plant construction was completed in January, 1975, it was determined that the pollutant control equipment did not meet particulate emission standards. This necessitated a comprehensive test program designed to quantify the extent of the pollution and evaluate the environmental impact of this plant. The test program was designed to measure the following flue gas parameters; particulate; SO2/SO3;NO(x);HCl:HF; total hydrocarbons; hydrocarbon compounds exceeding 1% of the total hydrocarbon value, but not more than 20; and trace metals. Atmospheric diffusion models were employed to assess the environmental impact of both the existing plant configuration and the proposed pollution control system. The proposed system consists of an electro-static precipitator exhausting to a 220 ft stack. Results of this analysis indicate that the proposed pollution control system represents a considerable improvement over the existing system, particularly in the sense that it should completely eliminate the downwash problem.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 13878, 13885

PREPARATION

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 13298, 13718

13215 (PB—295814) **For today: membrane-produced gasahol. for tomorrow: membrane-produced alcohol.** (Columbia Univ., New York (USA). Dept. of Chemical Engineering and Applied Chemistry). 1979. 12p. NTIS PC A02/MF A01.

This pamphlet, shows in charts the following: (1) Conventional process for production of fuel-grade ethanol from sugars; (2) Alcohol from grain or molasses with membrane treatment of stillages; (3) Treatment costs for stillages; (4) Membrane-controlled fermentation of sugars to ethanol; (5) Membrane facilitated hydrolysis of cellulose.

13216 (SERI/TP—33-285, pp 77-78) **Selective solvent extraction in utilization of stored solar energy in cellulosic biomass.** Tsao, G.T. (Purdue Univ., West Lafayette, IN). Oct 1979.

From 3. annual biomass energy systems conference; Golden, CO, USA (5 Jun 1979).

Cellulosic materials such as cornstalks used in conversion processes are usually made of three major components: cellulose, hemicellulose, and lignin. In utilization of such crude mixtures, fractionation of the raw materials into pure components usually will result in upgrading the value. Cellulose, in fact, is difficult to hydrolyze due to two main obstacles, one of which is the presence and the interference of lignin that cements cellulose fibers together. The other factor that makes cellulose resistant to hydrolysis is the highly ordered crystalline structure of cellulose. In order to overcome the two obstacles, Purdue researchers have employed solvents to dissolve cellulose. Once it is dissolved into a liquid, there is no longer crystalline structure nor the interference by lignin. Consequently, the treated cellulose becomes easily hydrolyzable by either acids and enzymes to glucose in high yields at a fast reaction rate. Another important feature of the Purdue Program is its heavy emphasis on the utilization of hemicellulose hydrolysate. In cornstalks, there is actually more hemicellulose than cellulose. Unless we can get a reasonable by-product credit from hemicellulose, cellulose alone cannot yield alcohol at a low cost. This fact was recognized very early in the program, when everyone else was paying attention only to cellulose hydrolysis and fermentation of glucose. The Purdue Program actually was stated as a study of fermentation of pentoses from hemicellulose. The production of butanediol, diacetyl, methyl ethyl ketone, ethanol, lactic acid, and pyruvic acid from hemicellulose hydrolysate is now being investigated.

13217 **Potential of energy farming for transport fuels in New Zealand.** Harris, G.S.; Leamy, M.L.; Fraser, T.; Dent, J.B.; Brown, W.A.N.; Earl, W.B.; Fookes, T.W.; Gilbert, J. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1979). 135p. (NZERDC—46).

Farming for production of fuel in New Zealand is discussed The main technical and economic aspects of energy farming and guidelines for development of this energy source are presented. Costs and energy ratios are given and areas of concern are highlighted. The results of studies on sugar beets, fodder beets, maize, lucerne, and radiata pine are discussed. The production of methanol, methane, and ethanol by fermentation and gasification are described. Environmental issues are also discussed. (DC)

13218 **Potential of energy farming for transport fuels in New Zealand: appendices.** Harris, G.S.; Leamy, M.L.; Fraser, T.; Dent, J.B.; Brown, W.A.N.; Earl, W.B.; Fookes, T.W.; Gilbert, J. Auckland, New Zealand; New Zealand Energy Research and Development Committee (1979). 135p. (NZERDC—46(App.)).

Appendices containng data on farming for production of fuel in New Zealand are found in this report. The titles of the appendices are: the suitability and distribution of land for the production of biomass; forestry; agricultural crops; maize grain production in the Waikato; processing routes for transport fuels; advisory panel research in the Waikato; scenarios for transport fuels to 2000; toxicity and other potential danger considerations associated with distribution; and opportunity costs. (DC)

SOLID WASTE FUELS

REFER ALSO TO CITATION(S) 13297, 13745, 13746, 13747, 13748, 13749, 13750, 13751, 13821

13219 (BNL—51050) **Carry-over grain stocks as an emergency fuel.** Davitian, H.; Serry, H. (Brookhaven National Lab., Upton, NY (USA)). Aug 1979. Contract EY-76-C-02-0016. 19p. Dep. NTIS, PC A02/MF A01.

In a typical year, the US has carry-over stocks of grain with a total energy content of 0.5 to 1.0 quad (10^{15} Btu). These stocks could serve as an emergency supply of solid fuel which could provide a partial substitute for coal in coal power plants. This report discusses the technical feasibility of burning grain-coal mixtures, the availability and price of carry-over stocks, and the amount of coal for which the grain could substitute.

13220 (CONF-790987—) **Proceedings of the DOE residue and waste fuels utilization program contract or review meeting.** (Brookhaven National Lab., Upton, NY (USA)). Dec 1979. Contract EY-76-C-02-0016. 432p. Dep. NTIS, PC A19/MF A01.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

Commercialization of wood combustion was discussed at this meeting. The use of agricultural and wood wastes as energy sources was also discussed. Separate abstracts were written for individual items. (DC)

13221 (CONF-790987—, pp 15p, Paper 1) **Wood commercialization plan study.** Dollard, J. (Dept. of Energy, Washington, DC). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The following categories are outlined: (1) recent events which should encourage wood energy; (2) benefits of a successful wood program; (3) high potential areas for wood energy; (4) residential heating; (5) industrial use of wood energy; and (6) utility use of wood energy. (DC)

13222 (CONF-790987—, pp 18p, Paper 3) **Systems support studies for Division of Fossil Fuel Utilization Residue and Waste Program.** Davitian, H. (Brookhaven National Lab., Upton, NY). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

Recommendations for technology development to support wood combustion commercialization needs are presented. The following subjects are discussed: technology development to increase the supply of wood for energy use; small scale harvesting technology; biomass forms; technology development to promote fuel flexibility; wood gasification; cofiring with coal; and research and development to ensure environmental acceptability. (DC)

13223 (CONF-790987—, pp 25p, Paper 5) **Direct combustion of industrial dry composite solid waste in suspension.** Desmon, L. (Peabody Gordon-Piatt, Winfield, KS). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

A project to identify classifications of industrial sites producing sufficient industrial wastes which could satisfy on-going energy requirements is described. The development of the technology necessary for commercialization of systems in which fossil fuel burners on existing burners can be retrofit with solid fuel suspension type burners is discussed. Several industrial sites have been visited. Installation of equipment in the test facility is 90% complete. (DC)

13224 (CONF-790987—, pp 29p, Paper 6) **Investigation of the rate of combustion of wood residue fuels.** Junge, D.C. (Oregon State Univ., Corvallis). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The objectives of this project are to develop a broad data base on the combustion characteristics of wood and bark residue fuels as they are burned in industrial spreader-stoker boilers and to use that data base to optimize the design and operation of wood and bark residue fired boilers for improved combustion efficiency and reduced air pollutant formation. A second objective is to develop a system for the combustion of carbon char generated in wood and bark fired boilers. The project has successfully developed a very broad data base on the combustion of wood and bark fuels including pelletized fuels. This data has been used to develop a Design Guideline Handbook for Industrial Spreader Stoker Boilers Fired With Wood and Bark Residue Fuels. Several full scale industrial boiler owners have modified their existing boilers based on the data collected with good results in terms of improved combustion conditions and reduced air pollutant emissions. It is anticipated that a similar handbook for boiler operators will serve to further improve the firing of wood and bark residue boilers. It is also anticipated that the carbon char burnup system developed under the contract will be used for full scale commercial application.

13225 (CONF-790987—, pp 12p, Paper 11) **Maine firewood study.** Swain, E.W. (Maine Audubon Society, Falmouth, ME). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The primary objective of the Maine Firewood Study was to determine the impediments to more widespread use of wood for energy and begin a process of information and assistance for resolving those problems. Eight basic tasks comprised the program: (1) a survey of landowner attitudes in Cumberland County; (2) an analysis with recommendations for landowner assistance programs; (3) an outline for similar programs employing firewood specialists; (4) an illustrated handbook on woodlot management for firewood production; (5) a detailed analysis of three firewood marketing systems; (6) a guidebook for entrepreneurs on the establishment of marketing outlets; (7) a series of draft legislative proposals to encourage increased wood fuel consumption; and (8) a survey of small-scale wood based industries. The second year of the Maine Firewood Study was undertaken to accelerate wood energy management and utilization. The program is proceeding on schedule in providing information and assistance to consumers and producers of wood energy.

13226 (PB—297178) **The firewood problem in Africa: report on the AFR firewood conference and request for field views.** French, D. (Agency for International Development, Washington, DC (USA)). Jun 1978. 56p. NTIS, PC A04/MF A01.

Firewood and charcoal are becoming less available and more expensive throughout Africa, presenting an immediate threat to the well-being of both rural and urban poor. This topic was the subject of the Firewood Workshop held June 12-14, 1978. This document discusses the need for collecting data on patterns of deforestation and the strategies for dealing with the problem. An annotated bibliography is included in the document for further investigation.

13227 (RHO-CD—829) **Wood pellet feasibility study.** Dohrer, C.H. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). 31 Oct 1979. Contract EY-77-C-06-1030. 133p. Dep. NTIS, PC A07/MF A01.

This study effort was undertaken to determine the feasibility of using pelletized wood as an alternative fuel supply while retaining the capabilities of returning to the use of coal without interrupting steam production. Pelletized wood fuel was fired in two of four boilers rated at 80,000 pounds of steam per hour each. No modifications to the existing systems were required in order to conduct the study. Wood pellets can be fired efficiently at up to 85 percent of boiler capacity without exceeding particulate emission or opacity standards which eliminates the need for gas control exhaust measures. The lower ash volume of wood pellets can produce a 75 percent savings in ash handling and disposal costs. The need for additional receiving, storage and conveyance facilities for dust control and reduction of the fire and explosion hazards presented by wood pellets cannot be justified by savings in fuel or operating costs. The estimated yearly delivered cost of wood pellets to Hanford exceeds the known yearly delivered cost of the equivalent Btu value of coal. The increased operating costs incurred by firing wood pellets are not offset by savings in ash handling and baghouse operating costs. Based on the capital cost of additional facilities for wood pellets and increased operating cost while using this fuel in lieu of coal, the use of wood pellets as an alternative to coal in the 200 West Area powerhouse is not economically feasible at this time. Wood pellet and coal prices should, however, remain under observation and the option of firing wood pellets be reviewed if a change in cost dictates an economic advantage. It is recommended that steam plants faced with expensive emission improvements or high fuel costs seriously consider the use of wood pellets as a substitute fuel.

HYDRO ENERGY

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 13630, 13631, 13632, 13633

13228 (PB—292745) **Potential use of small dams to produce power for low-income communities.** Allen, M.M. (International Science and Technology Inst., Inc., Washington, DC (USA); Polytechnic Inst. of New York, Brooklyn (USA). Center for Regional Technology). 4 Aug 1978. Contract CSA-B8B-5584. 220p. NTIS, PC A10/MF A01.

An alternative source of energy which would have a stable cost and alleviate the economic strain of rising fossil fuels is the development of small dam sites to produce hydroelectric power. This report addresses the many issues involved in estimating the potential contribution of hydropower to the energy supply. The issues discussed include: (1) physical characteristics, (2) environmental and safety considerations, (3) institutional constraints, (4) economic issues, and (5) current governmental programs.

SITE GEOLOGY AND METEOROLOGY

REFER ALSO TO CITATION(S) 13716

13229 (PB—297571) **Seismic risk analysis for California State Water Project, Reach C.** Shah, H.C.; Movassate, M.; Zsutty, T.C. (Stanford Univ., CA (USA). John A. Blume Earthquake Engineering Center). Mar 1976. 119p. NTIS, PC A06/MF A01.

A seismic hazard map for the region described as 'Reach C' for the California Water Project is developed in this report. 'Reach C' for this work is defined as that portion of the California Water Project from Tehachapi Afterbay up to and including the Perris Dam and Lake. The key facilities within this reach include: (1) Tehachapi Afterbay, (2) Cottonwood Power Plant Site, (3) Pearblossom Pumping Plant, (4) Mojave Siphon, (5) Silverwood Dam and Lake, (6) San Bernardino Tunnel, (7) Devil Canyon Power Plant, (8) Santa Ana Valley Pipeline, (9) Perris Dam and Lake, and (10) Perris O and M Subcenter. The report discusses the data base, the seismic sources considered, and the resulting iso-acceleration maps. Relative risks of various sites and their implications are presented.

PLANT DESIGN AND OPERATION

13230 **Evaluating the vibration state of a hydrogenerator stator winding from the results of selective measurements.** Bryzgalov, V.I.; Kulak, V.M.; Sokolov, A.E. *Sov. Power Eng. (Engl. Transl.);* 7: No. 5, 276-280(May 1978).

Translated from Elektr. Stn.; 7: No. 5, 28-31(May 1978).

From operating experience with the generators at the Krasnoyarsk Hydroelectric Station it follows that in order to provide high operating reliability of large hydrogenerators with direct water cooling of the stator winding it is necessary to provide periodic operational monitoring of the stator winding vibration. A mathematical solution for determining stator winding vibration by using vibration measurements on selected stator elements, the statistical characteristics of those elements and probability theory is described. The calculated results were in good agreement with experimental data. It was shown to be practical to evaluate the vibration state of a hydrogenerator stator winding from the position of the interval of probable values of the maximum winding vibration relative to the level of the allowable winding vibration. (LCL)

REGULATIONS AND LICENSING

REFER ALSO TO CITATION(S) 13692

SOLAR ENERGY

REFER ALSO TO CITATION(S) 13717

13231 (CONF-780754—, pp 123-124) **Battelle's Pacific Northwest Laboratory Solar Technology Transfer Program.** Werry, E.V. 1978.

From Solar Northwest conference; Portland, OR, USA (14 Jul 1978).

A program to present information on technically feasible and economically competitive solar technology to the Northwest organizations most likely to use it in the near future is described briefly. (MHR)

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 13716, 13717

13232 (LA-UR—80-17) **Application of the adjoint method in atmospheric radiative transfer calculations.** Gerstl, S.A.W. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 20p. (CONF-791162—1). Dep. NTIS, PC A02/MF A01.

From Workshop on atmospheric aerosols: their formation, optical properties and effects; Baltimore, MD, USA (6 Nov 1979).

The transfer of solar radiation through a standard mid-latitude summer atmosphere including different amounts of aerosols (from clear to hazy) has been computed. The discrete-ordinates (S/sub N/) method, which has been developed to a high degree of computational efficiency and accuracy primarily for nuclear radiation shielding applications, is employed in a forward as well as adjoint mode. In the adjoint mode the result of a transfer calculation is an importance function (adjoint intensity) which allows the calculation of transmitted fluxes, or other radiative responses, for any arbitrary source distribution. The theory of the adjoint method is outlined in detail and physical interpretations are developed for the adjoint intensity. If, for example, the downward directed solar flux at ground level, F/ sub λ/ (z = 0), is desired for N different solar zenith angles, a regular (forward) radiative transfer calculation must be repeated for each solar zenith angle. In contrast, only 1 adjoint transfer calculation gives F/sub λ/ (z = 0) for all solar zenith angles in a hazy aerosol atmosphere, for 1 wavelength interval, in 2.3 seconds on a CDC-7600 computer. A total of 155 altitude zones were employed between 0 and 70 km, and the convergence criterion for the ratio of fluxes from successive iterations was set at 2×10^{-3}. Our results demonstrate not only the applicability of the highly efficient modern S/sub N/ codes, but indicate also conceptual and computational advantages when the adjoint formulation of the radiative transfer equation is used.

13233 (LBL—10243) **Measurement and analysis of circumsolar radiation.** Grether, D.F.; Evans, D.; Hunt, A.; Wahlig, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 11p. Dep. NTIS, PC A02/MF A01.

Four instrument systems called Circumsolar Telescopes are used to measure the solar and circumsolar radiation for application to solar energy systems that employ lenses or mirrors to concentrate the incident sunlight. circumsolar radiation results from the scattering of direct sunlight through small angles by atmospheric aerosols (dust, water droplets or ice crystals in thin clouds, etc.). The solar energy system will typically collect all of the direct solar radiation (that originating from the disk of the sun) plus some fraction of the circumsolar radiation. The exact fraction depends upon many factors, but primarily upon the angular size (field-of-view) of the receiver. A knowledge of the circumsolar radiation can be used as a factor in the optimization of a receiver design, as one measure of the suitability of a geographic region for concentrating systems, or as input to comparison studies of competing designs at a particular location. Each measuring system has a scanning telescope mounted on a precision solar tracker. The telescope is mechanically scanned thru an arc of 6^0 with the sun at the center of the arc. A digitization of the brightness of the sun or circumsolar radiation is taken every 1.5′ of arc, with a complete scan taking one minute of time. Auxiliary instruments include a pyrheliometer and two pyranometers, one mounted in the usual horizontal position and one tracking the sun. The telescope and pyrheliometer have batched ten position filter wheels: one open position, eight interference filters that divide the solar spectrum into eight intervals of roughly equal energy content, and one opaque filter to monitor detector noise. The data are recorded on magnetic tape, with one tape holding one week's worth of data per telescope. The tapes are shipped to LBL for computer processing. (WHK)

13234 (SERI/TR—335-344) **Direct insolation models.** Bird, R.; Hulstrom, R.L. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 58p. Dep. NTIS, PC A04/MF A01.

Several recently published models of the direct component of the broadband insolation are compared for clear sky conditions. The comparison includes seven simple models and one rigorous model that is used as a basis for determining accuracy. Where possible, the comparison is made between the results of each model for each atmospheric constituent (H_2O, CO_2, O_3, O_2, aerosol and molecular scattering) separately as well as for the combined effect of all of the constituents. Two optimum simple models of varying degrees of complexity are developed as a result of this comparison. The study indicates: aerosols dominate the attenuation of the direct beam for reasonable atmospheric conditions; molecular scattering is next in importance; water vapor is an important absorber; and carbon dioxide and oxygen are relatively unimportant as attenuators of the broadband solar energy.

13235 (SERI/TR—8150-1) **Evaluation of the typical meteorological years for solar heating and cooling system studies. Final report.** Freeman, T.L. (and, OH (USA)). Dec 1979. Contract EG-77-C-01-4042. 77p. Dep. NTIS, PC A05/MF A01.

This report is a summary of an evaluation of the weather data set, generated at Sandia Laboratories, known as the Typical Meteorological Year (TMY) Data. The purpose of the evaluation is to determine how well the TMY data represent actual long-term weather data in affecting the performance of solar heating and cooling systems. The two data sets are compared through detailed SHAC simulation.

13236 (UHMET—79-04) **Project Ahupua'a: solar meteorological field measurements on the Island of Hawaii, summer 1978. 2. Eastern flank of Mauna Loa.** Ekern, P.C.; Garrett, A.J. (Hawaii Univ., Honolulu (USA). Dept. of Meteorology). Aug 1979. Contract EG-77-G-03-1617. 63p. Dep. NTIS, PC A04/MF A01.

During 1-11 June 1978, solar radiation and other meteorological data were gathered at eight stations in a nearly linear transect on the windward eastern slopes of Hawaii, extending from the coast of Hilo, Hawaii to Mauna Loa Observatory (MLO), 60 km inland and 3400 m higher. In general, synoptic conditions were representative of normal early summer trade wind weather with a frontal remnant to the north, and a small westward-moving depression to the south. Solar radiation distributions followed climatological rainfall patterns;

the driest areas were sunniest. At the wettest sites, underneath the orographic cloud, measured global solar radiation was only 50% of clear-sky potential, and the diffuse component probably accounted for more than 50% of the global. Consequently, effective concentration of solar radiation for use as an alternate energy resource will be difficult in such areas. The orographic cloud developed during the day in anabatic/trade winds of 2 to 4 m s^{-1}, which sharply reduced afternoon solar radiation at all sites, including MLO on 7 out of 11 days. Moist upslope flow penetrated the trade wind inversion by 0.5 to 1.5 km on weak inversion days (~ +1 °C). When the inversion was strong (+5 to +8 °C), MLO was dry and clear all day. Cloudiness, and hence insolation, varied greatly from day-to-day due to passage of trade wind cloud masses and jet stream cirrus. Even so, the island effect was always significant. Thus, our data and analyses can be used by mesoscale numerical modelers, particularly those attempting to simulate orographic cloud development.

ECONOMICS

REFER ALSO TO CITATION(S) 13318, 13660

13237 (SERI/TP—351-529) **Goals: objects and measures of progress.** Brown, K.C. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 8p. (CONF-791024—13). Dep. NTIS, PC A02/MF A01.

From Solar industrial process heat conference; San Francisco, CA, USA (31 Oct 1979).

One of the most useful outputs of systems and market analysis is a concise statement of technology goals. The concept of goal-setting as previously developed in other programs of research and development is introduced. In this context goals are merely the visible output of a systematic translation of market requirements into research and development actions. Cost goals are one type of information linkage between market and research, although a complete statement of technology goals must include both tangible and intangible physical requirements as well. The process of devising goals and measuring progress against these goals is briefly illustrated in an example from the Solar Industrial Process Heat Program. The process of establishing a program framework and program goals has not been completed for solar process heat; it is hoped that this paper will encourage steps in this direction.

13238 (SERI/TR—434-191) **Municipal bond financing of solar energy facilities.** White, S.S. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1979. Contract EG-77-C-01-4042. 83p. Dep. NTIS, PC A05/MF A01.

The application of the laws of municipal bond financing to solar facilities is examined. The type of facilities under consideration are outlined. The general legal principles of municipal securities financing are discussed. The effect of recent decisions applying antitrust liability to municipal corporations is also discussed. Five specific types of municipal bonds are explained. The application of Section 103 of the Internal Revenue Code of 1954, as amended, to the issuance of municipal bonds for solar facility financing is examined also. Five bond laws of five representative states are examined and whether the eight types of solar facilities under consideration could be financed under such law is discussed. The application of the general legal principle is illustrated. Three hypothetical situations are set forth and common legal issues to be confronted by city officials in proposing such financing are discussed. These issues will be raised in most financings, but the purpose is to examine the common context in which they are raised. It is concluded that if it can be shown that the purpose of the solar facilities to be financed is to benefit the public, all legal obstacles to the use of municipal financing of solar facilities can be substantially overcome.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 13238, 14253

13239 (CONF-780754—, pp 7-13) **Solar energy plan for the Western Region.** 1978.

From Solar Northwest conference; Portland, OR, USA (14 Jul 1978).

Thirteen Western States, as the result of a nine-month planning effort, recommend a plan for encouraging the use of solar energy in the West and an implementing organization to carry out the plan. This summary describes how the plan was developed, the programs and projects comprising the plan, overall cost estimates, and the structure of the proposed implementing organization, Western Solar Utilization Network (Western SUN).

13240 (CONF-7809197—) **Proceedings of the workshop on stratospheric and mesospheric impacts of Satellite Power Systems (SPS).** (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 120p. Dep. NTIS, PC A06/MF A01.

From Workshop on stratospheric and meslpheric impacts of satellite power systems; Rosemont, IL, USA (6 Sep 1978).

Three general issues were identified as potentially significant and deserving of consideration. These general issues are summarized as follows: (1) Composition perturbations due to: (a) rocket exhaust emissions, and (b) reentry effects; (2) Climatic effects due to: (a) increased noctilucent cloud formation, and (b) composition perturbations; and (3) Effects of localized energy injection: (a) rocket exhaust thermal energy and (b) microwave absorption. The conclusions and recommendations of the workshop participants are summarized for each individual issue. The basis for these conclusions is contained in the participants' discussion as summarized in the preceding section and in the written contributions prepared by individual participants and collected together in Appendix B. The recommendations for further research also in general follow from the discussion, but are also based upon the assumption that two years would be available from the date of the workshop in which to carry them out before the final environmental impact assessment would be due. Finally, a list of general recommendations made by workshop participants is given. (WHK)

13241 (SERI/TR—354-245) **Residential solar energy users: a review of empirical research and related literature.** Unseld, C.T.; Crews, R. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1979. Contract EG-77-C-01-4042. 109p. Dep. NTIS, PC A06/MF A01.

This report reviews 15 empirical studies of residential solar energy users and related literature on residential solar energy use. The purpose of the review is to summarize and analyze the experiences of residential solar users for helping formulate policies concerning the accelerated commercialization of solar technologies. Four of the studies employed case histories or focus group techniques. The 11 questionnaire studies represented interviews with over 1,600 owners of solar systems. The demographic characteristics of samples are listed and compared; research findings and conclusions are presented. Findings on user satisfaction and system performance, possible reasons for evidence of lacking correlation between them, and implications for consumer protection and future research are discussed. General findings are: (1) systematic research on the experiences of solar users is lacking - much research remains to be done; (2) the reported overall experiences of users has been very positive; (3) user reports indicate that system performance is generally good but there is some evidence that user reports are not accurate measures of actual performance; (4) a need exists for adequate consumer protection; (5) design or installation problems are evidenced in significant numbers of early solar installations; and (6) these problems evidently are resolvable. An annotated bibliography describes 10 other studies in progress.

SOLAR ENERGY CONVERSION

REFER ALSO TO CITATION(S) 13787

13242 (N—79-26536) **Cost/benefit analysis of a solar power plant supplemented by diesel generation in comparison with a solely diesel system - optimizing for size and initial investment in an isolated area. Possibilite de placement et demensionnement optimal d'une centrale electrosolaire a tour associee a un diesel dans un centre isole.** Manteau, G. (Electricite de France, 78 - Chatou. Service Machines et Automatismes de Production). Apr 1977. 29p. NTIS, PC A03/MF A01.

Economic and climatic conditions pertinent to the installation of a solar power plant are studied. The reduction of kWh cost vis a vis wholly diesel electrical energy generation is considered. The tradeoff between installation size and optimal output value is defined and identified for the two systems respectively. The study is hypothetical and is intended only as a guideline for future real market surveys.

13243 (N—79-26537) **Study of low output solar energy power plants rapport de stage: etude de centrale solaires de faible puissance.** Ribiere, P.; Weyland, P. (Electricite de France, 78 - Chatou. Service Machines et Automatismes de Production). May 1977. 138p. NTIS, PC A07/MF A01.

Various components used in combination with solar energy to produce a thermodynamic effect in a low output (less than or equal to 1MW) power generating system are studied in order to determine their economic feasibility. Four possible installations are envisaged and evaluated for their cost vis a vis the energy obtained. These are mini solar power plants (2.3 to 50 kw output) with fixed collectors, solar heat sinks with chemical or mechanical energy conversion, solar power plants (200 kw nominal output) with heliostat collectors,

and tower-type solar power plants (for a nominal output of 1 MW). Related technologies such as bio-conversion, chemical reactors, and electrical energy storage are discussed and related to the size of the solar power plant chosen.

13244 (PB—292384) **Cultural resource survey and evaluation of system verification unit sites, transmission line and access road rights-of-way: Wind Energy Project, Albany and Carbon counties, Wyoming.** Carpenter, K.; Wheeler, C.; Sullivan, M. (Western Cultural Resources Management, Inc., Boulder, CO (USA)). Jan 1979. 37p. NTIS, PC A03/MF A01.

Between October 27 and October 29, 1978, two archeologists and a paleontologist affiliated with Western Cultural Resource Management of Boulder, Colorado, surveyed an area around Medicine Bow, Wyoming to locate and evaluate any cultural resources that might be affected by the Bureau of Reclamation's proposed Wind Energy Project. Although no paleontological or historical sites or remains were located, two archeological sites and fifteen (15) loci of isolated archeological artifacts were discovered. Since both sites were located along the proposed transmission line right-of-way from alternate 'Site C' to the existing transmission line along Wyoming Highway 487, and not on any of the System Verification Unit locations, it is recommended that direct site impact during transmission line construction be avoided. Construction on any of the alternate system verification unit locations will not adversely affect any cultural resources, either historic or archeological.

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 13305, 13380, 13598

13245 (COO—4518-T1) **Degradation of ITO/silicon solar cells. Final report.** Wilmsen, C.W. (ed.). (Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering). 1978. Contract EG-77-S-02-4518. 30p. Dep. NTIS, PC A03/MF A01.

The research under this contract investigated the degradation mechanisms and projected lifetime of indium tin oxide (ITO/P-silicon) solar cells. Both single and polycrystalline silicon cells were investigated. Thermal degradation of the cells was shown to proceed by the growth of an interfacial SiO_2 which resulted from oxygen diffusion through the ITO. The growth of the interfacial SiO_2 causes reduction in fill factor but not V/sub oc/ or I/sub sc/ until the degradation is severe. While thermal degradation occurs, it proceeds very slowly at 50°C and the cell efficiency is projected to remain above 50% of its original value for 10^5 years at this temperature. Cells subjected to illuminated load testing at room temperature for 840 hours showed no reduction in output. However, some changes were noted in the dark characteristics. The mechanism causing the change is not known. Preliminary noise spectral density reliability tests were conducted but the results were inconclusive.

13246 (DOE/ET/20429—1) **Cadmium sulfide/copper sulfide heterojunction cell research. Final report, September 30, 1977-July 31, 1979.** Szedon, J.R.; Shirland, F.A.; Biter, W.J.; O'Keeffe, T.W.; Stoll, J.A.; Fonash, S.J. (Westinghouse Research and Development Center, Pittsburgh, PA (USA); Pennsylvania State Univ., University Park (USA)). 31 Jul 1979. Contract EG-77-C-03-1577. 186p. Dep. NTIS, PC A09/MF A01.

The objective of this program is to conduct research on solar cells of the copper sulfide/cadmium sulfide (and cadmium sulfide-zinc sulfide alloy) type with the goal of producing thin film cells capable of 10% AM1 conversion efficiency with less than 5% degradation in performance over a period of 20 years. New evaluation methods reveal cell microstructure details (grain size, Cu_2S penetration into grain boundaries, etch pit depth and density) whose modification and control should allow reproducible achievement of at least 9% conversion efficiency. Cell degradation primarily involves changes in heterojunction collection efficiency, not minority carrier transport in the thin Cu_2S, light absorbing layer. Analysis of current technology predicts a selling price of $0.33/peak watt (1975 dollars) for glass encapsulated, 8% efficient modules. More conservative material use, especially gold grid electrode, should allow a selling price of $0.38/peak watt. Suggestions are made for further work to meet the program performance and cost objectives.

13247 (DOE/ET/23002—T2) **Polyacetylene, (CH)/sub x/, as an emerging material for solar cell applications. Technical progress report, April-June, 1979.** Heeger, A.J.; MacDiarmid, A.G. (Pennsylvania Univ., Philadelphia (USA)). 28 Jul 1979. Contract AC04-79ET23002. 40p. Dep. NTIS, PC A03/MF A01.

The potential of (CH)/sub x/ as a photosensitive material for use in solar cell applications is studied. Schottky barrier photovoltaic cells were fabricated with metallic AsF_5-doped (CH)/sub x/ on semiconducting n-Si and n-GaAs, with metallic Na-doped (CH)/sub x/ on semiconducting p-Si, with K-doped (CH)/sub x/ as an n-type semiconductor in contact with an electronegative metal (Au), and with undoped trans-(CH)/sub x/ as a p-type semiconductor in contact with electropositive metals (Na, Hg, In and Sn). The variation of barrier heights in metallic AsF_5-, PF_5-, and BF_3-doped (CH)/sub x/ in contact with n-type semiconducting Si was studied. p-n heterojunction solar cells were fabricated with undoped (CH)/sub x/ on ZnS. Open circuit photovoltage was 0.8 V; short circuit current was limited by series resistance. The agreement in spectral response obtained from photoconductivity and photovoltaic effect has shown that the carriers are produced in the (CH)/sub x/ and that the band gap is indeed ~ 1.5 eV. Trapping effects have been identified. Work on the construction of a (CH)/sub x/ field effect transistor is progressing. This device will be used to obtain the majority carrier mobility. (WHK)

13248 (DOE/ET/23006—1) **Investigation of solar cells based on Cu_2O. Quarterly progress report, May 1-July 31, 1979.** Olsen, L.C. (Washington Univ., Richland (USA). Joint Center for Graduate Study). 7 Sep 1979. Contract AC04-79ET23006. 35p. Dep. NTIS, PC A03/MF A01.

Efforts during this quarter have involved a detailed study of photocurrent from Cu/Cu_2O Schottky barriers, development of a MBE system, and studies of reactively sputtered ZnO films. Optical constants were determined for Cu films as a function of film thickness and utilized to determine optimum AR coating thicknesses to maximize the photocurrent from Cu/Cu_2O cells. Using results of these analyses, an AM1 photocurrent of 7.4 mA/cm^2 has been obtained. Fabrication and purchasing of parts for a three-source MBE system has progressed well. Conductive and transparent ZnO films were deposited by reactively sputtering zinc. Films exhibiting a sheet resistance in the range of 10^3 to 10^5 Ω/cm^2 have been deposited on quartz.

13249 (DOE/ET/23010—T1) **Cuprous oxide photovoltaic cells. First quarterly technical progress report, April 9, 1979-July 8, 1979.** Trivich, D.; Wang, E.Y.; Komp, R.J. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). 1979. Contract AC04-79ET23010. 31p. Dep. NTIS, PC A03/MF A01.

In order to investigate Cu_2O MIS structures and heterojunctions, equipment capabilities were expanded. The apparatus for the preparation of thin films includes ion beam sputtering equipment and electron beam evaporation equipment, as well as expanded capabilities for thermal evaporation. The cells can be studied by a variety of techniques including I-V measurements in the dark and under illumination, capacitance-voltage measurements as a function of frequency and temperature, spectral response, surface photovoltage for evaluation of diffusion length, etc. Access to Auger/ESCA equipment is available for surface analysis. The MIS structures chosen for initial study were Metal/SiO_2/Cu_2O using the metals Au, Ag, Cu, and Al and various thicknesses of SiO_2. The results indicate that the band bending on V/sub oc/ depend primarily on the work function of the metal and that interface states play a secondary role. It appears that the preparation of the cells can be further improved upon to secure more definitive results. It is planned to investigate other oxide interlayers. Further Auger/ESCA studies are planned to determine the influence of chemical changes. Work on heterojunctions on Cu_2O has been initiated. The first system explored was ZnSe/Cu_2O. It appears that chemical changes at the interface have an important effect on the properties. In the future, the emphasis will be placed on heterojunctions of Cu_2O with other oxide semiconductors.

13250 (DOE/ET/23012—T1) **High efficiency thin film CdTe solar cells. First quarterly progress report, March 19-June 18, 1979.** Serreze, H.B.; Entine, G.; Goldner, R.B. (Radiation Monitoring Devices, Inc., Watertown, MA (USA)). Jul 1979. Contract AC04-79ET23012. 17p. Dep. NTIS, PC A02/MF A01.

During the first quarter of this contract, facilities for the high vacuum evaporation of thin film CdTe were prepared. A number of evaporations were performed of both p-type (phosphorus doped) and n-type (halogen doped) CdTe on both conductive and non-conductive substrates. Optical, physical, and electrical evaluations were made. Initial results indicate that the films are predominantly cubic, but that film resistivity is generally still too high and that an anomalous barrier exists at the ITO/n-CdTe interface.

13251 (DOE/ET/23013—T2) **Controlled cadmium telluride thin films for solar cell applications (emerging materials systems for solar cell applications). Quarterly progress report No. 1, April 9-July 8, 1979.** Vedam, K. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). Aug 1979. Contract AC02-79ET23013. 12p. Dep. NTIS, PC A02/MF A01.

Preparation and properties of cadmium telluride thin films for use in solar cells are studied. CdTe sputter deposition, crystal doping, and carrier typing are discussed. Future experimental plans are described. (WHK)

13252 (DOE/ET/23047—T1) **Thin film polycrystalline silicon solar cells. Quarterly report No. 2, April 1, 1979-June 30, 1979.** Ghosh, A.K.; Feng, T.; Maruska, H.P.; Fishman, C. (Exxon Research and Engineering Co., Linden, NJ (USA). Advanced Energy Systems Labs.). 1979. Contract AC02-79ET23047. 45p. Dep. NTIS, PC A03/MF A01.

The theory of polycrystalline solar cells that was reported last quarter has been entended by introducing effects due to the reduction of grain boundary states. The results show that a large improvement in efficiency can be attained either by increasing the grain size or by passivating the grain boundary states to reduce the number of recombination centers. Experimental results are presented to show grain size distribution in Wacker polycrystalline silicon. Preliminary Hall mobility measurements are presented as a function of temperature. Experimental results and analysis of diffused p on n cells are reported. Preliminary studies of grain boundary passivation and stability of SnO_2/n-Si solar cells are presented.

13253 (DOE/ET/23103—18) **Theory of thin-film photovoltaics. Technical report No. 3. Non-ideal diode factors.** Boeer, K.W. (Delaware Univ., Newark (USA). Coll. of Engineering). 1979. Contract AC01-79ET23103. 23p. Dep. NTIS, PC A02/MF A01.

It is shown that non-ideal diodes with an A-factor in the exponent larger than two can be explained when the junction recombination starts to saturate. In photovoltaic cells in which the density of minority carriers can be varied independent of the bias voltage, this behavior becomes transparent and is used as an examples for the proposed model.

13254 (DOE/ET/32208—3) **Vacuum deposited polycrystalline silicon films for solar cell applications. Quarterly report, April 1-June 30, 1979.** Feldman, C.; Satkiewicz, F.G. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Aug 1979. Contract ET-78-A-03-2208. 55p. Dep. NTIS, PC A04/MF A01.

Research is being conducted on grain growth phenomena and interface interactions pertaining to an all-vacuum deposition technique for fabricating thin-film polycrystalline silicon solar cells. Investigations this quarter dealt primarily with the structure silicon/TiB_2/alumina substrate, which seems to be the most satisfactory from the standpoint of stability and potential applicability to low-cost solar cells. Secondary ion mass spectrometry, scanning electron microscopy, and x-ray diffraction analysis and revealed important information concerning growth processes and interfacial interactions. Deposition of silicon in the presence of hydrogen ($\sim 5 \times 10^{-5}$ Torr) resulted in devices inferior to those fabricated in high vacuum. It is doubtful that much, if any, hydrogen remained in the film under the high temperature processing conditions. Silicon growth from the TiB_2 coated substrates was observed to start from larger seeds than was observed on bare alumina substrates. The larger silicon crystallites observed on the TiB_2/alumina are believed to arise from growth on an intermediate Ti-Si phase. A series of experiments on top electrode preparation indicates that Ti/Ag electrodes heated for 30 min at 500°C in air gives the best results for the polycrystalline devices as they are presently constructed.

13255 (DOE/JPL/954334—9) **Low Silicon Solar Array Project. Feasibility of low-cost, high-volume production of silane and pyrolysis of silane to semiconductor-grade silicon. Quarterly progress report, October-December 1978.** Breneman, W.C.; Farrier, E.G.; Morihara, H. (Union Carbide Research Inst., Tarrytown, NY (USA)). 1978. Contract NAS-7-100-954334. 95p. Dep. NTIS, PC A05/MF A01.

Research on silane production in a hydrogenation reactor is described. The kinetics and chemical equilibrium for the liquid phase disproportionation of H_2SiCl_4 and $HSiCl_3$ were studied and results are presented and discussed. Status of the studies on the feasibility and cost of manufacturing semiconductor grade polycrystalline silicon by the pyrolysis of silane in a fluid bed reactor and in a free space reactor is reported. Process design, the waste disposal system, and equipment specifications for the fluid bed pyrolysis of silane for silicon production are described. (WHK)

13256 (DOE/JPL/954334—10) **Low Cost Solar Array Project. Feasibility of the silane process for producing semiconductor-grade silicon. Final report, October 1975-March 1979.** (Union Carbide Corp., New York (USA)). Jun 1979. Contract NAS-7-100-954334. 365p. Dep. NTIS, PC A16/MF A01.

The commercial production of low-cost semiconductor-grade silicon is an essential requirement of the JPL/DOE (Department of Energy) Low-Cost Solar Array (LSA) Project. A 1000-metric-ton-per-year commercial facility using the Union Carbide Silane Process will produce molten silicon for an estimated price of $7.56/kg (1975 dollars, private financing), meeting the DOE goal of less than $10/kg. Conclusions and technology status are reported for both contract phases, which had the following objectives: (1) establish the feasibility of Union Carbide's Silane Process for commercial application, and (2) develop an integrated process design for an Experimental Process System Development Unit (EPSDU) and a commercial facility, and estimate the corresponding commercial plant economic performance. To assemble the facility design, the following work was performed: (a) collection of Union Carbide's applicable background technology; (b) design, assembly, and operation of a small integrated silane-producing Process Development Unit (PDU); (c) analysis, testing, and comparison of two high-temperature methods for converting pure silane to silicon metal; and (d) determination of chemical reaction equilibria and kinetics, and vapor-liquid equilibria for chlorosilanes.

13257 (DOE/JPL/954334—11) **Low Cost Solar Array Project: experimental process system development unit for producing semiconductor-grade silicon using the silane-to-silicon process. Quarterly progress report, April-June 1979.** (Union Carbide Corp., New York (USA)). 1979. Contract NAS-7-100-954334. 30p. Dep. NTIS, PC A03/MF A01.

The overall objective of the LSA Silicon Material Task is to establish a chemical process for producing silicon at a rate and price commensurate with the production goals of the LSA project for solar-cell modules. This material must be suitable for utilization in the large-area sheet process and in the automated process for the fabrication of solar cells. As part of the overall Silicon Material Task, Union Carbide developed the silane-silicon process and advanced the technology to the point that it has a definite potential for providing high-purity polysilicon on a commercial scale at a cost of $14/kg by 1986 (1980 dollars). The Phase III program (initiated in April 1979) is aimed at establishing the practicality of the process by pursuing the followng specific objectives: (1) design, fabricate, install, and operate an Experimental Process System Development Unit (EPSDU) sized for 100 MT/Yr to obtain extensive performance data to establish the data base for the design of commercial facilities; (2) perform supporting research and development to provide an information base usable for the EPSDU and for technological design and economic analysis for potential scale-up of the process; and (3) perform iterative economic analyses of the estimated product cost for the production of semiconductor-grade silicon in a facility capable of producing 1000 MT/Yr. The three basic process steps entail converting M-G silicon to trichlorosilane, redistributing the trichlorosilane to produce silane, and thermally decomposing the silane to form polycrystalline silicon powder. The powder is then melted and the molten silicon is cast into rods for subsequent fabrication of solar cells. Technical progress is reported. (WHK)

13258 (DOE/JPL/954343—79/16) **Process feasibility study in support of silicon material, Task 1. Quarterly technical progress report (XVI), June-August, 1979.** Li, K.Y.; Hansen, K.C.; Yaws, C.L. (Lamar Univ., Beaumont, TX (USA). Dept. of Chemical Engineering). Sep 1979. Contract NAS-7-100-954343. 45p. Dep. NTIS, PC A03/MF A01.

During this reporting period, primary efforts were expended on process system properties, chemical engineering and economic analysis. Analysis of process system properties was continued for silicon source materials under consideration for producing silicon. The following property data are reported for dichlorosilane which is involved in processing operations for silicon: critical constants, vapor pressure, heat of vaporization, heat capacity, density, surface tension, thermal conductivity, heat of formation and Gibb's free energy of formation. The properties are reported as a function of temperature to permit rapid engineering usage. Major efforts were expended on completion of the preliminary economic analysis of the BCL Process (Battelle Columbus Laboratories). Cost analysis results for the process (Case A-two deposition reactors and six electrolysis cells) are presented based on a preliminary process design of a plant to produce 1000 metric tons/year of silicon. Fixed capital investment estimate for the plant is $12.47 million (1975 dollars) ($17.47 million, 1980 dollars). Product cost without profit is %8.63 $/kg of silicon (1975 dollars) (12.1 $/kg, 1980 dollars).

13259 (DOE/JPL/954344—1) **Web-dendritic growth. Final report, October 1975-August 1977.** Hilborn, R.B. Jr.; Faust, J.W. Jr.; Rhodes, C. (South Carolina Univ., Columbia (USA). Coll. of Engineering). 1977. Contract NAS-7-100-954344. 188p. Dep. NTIS, PC A09/MF A01.

This final report gives the results of work performed by the University of South Carolina to develop methods of producing large areas of silicon ribbon by the web-dendritic method. A prototype web-dendritic growth machine, on hand at the beginning of the contract, was assembled and activated. A program for investigating the role of the various machine design parameters on the growth of web-dendritic ribbon was carried out during the duration of the contract. The development of the machine proceeded to the point where ribbons could be reproducibly grown up to lengths of 1 meter, with widths increasing linearly from a minimum, at the initiating seed button, up to 1 cm. at the point of termination of growth. Considerable thermal data was collected and evaluations were made of actual seeding and growth for variations in a large number of parameters affecting heat loss. From this we found for achieving suitable growth that the mechanical system should be very rigid and stable, and the tolerances and specifications of the quartz crucibles must be far tighter than normal quartz tolerances. The widening rates of the ribbons were found to be a function of the temperature gradient rather than the temperature differences alone. A twin spacing in the seed of 3μ - 2μ was found to be unfavorable for growth; whereas spacing of 9μ - 2μ and 8μ - 2μ were favorable. It was found, however, that the spacing of 8μ - 2μ sets an upper limit of 4 cm/min on the maximum achievable rate. Extensive

thermal modeling studies were carried out to investigate the effect of furnace design parameters on the temperature distributions in melt and the growth of the dendritic-web ribbon. From this study it was found that the pull rate of the ribbon is strongly dependent on the temperature of the top thermal shield, the spacing between this shield and the melt, and the thickness of the growing web.

13260 (DOE/JPL/954355—2) **Large area silicon sheet by EFG. Second quarterly report, April 1-June 30, 1979.** (Mobil Tyco Solar Energy Corp., Waltham, MA (USA)). 15 Jul 1979. Contract NAS-7-100-954355. 101p. Dep. NTIS, PC A06/MF A01.

In Furnace No. 1 during this quarter, experiments were conducted in which the total argon purge rate in this furnace was decreased. A number of extremely significant changes in the crystallographic structure and electronic quality of the ribbons were observed in these experiments. Ribbon segments were grown in which the equilibrium defect structure was no longer present and the electrical properties improved to the extent that cells of 50 cm^2 area having AM1 efficiencies over 11% could be prepared. In Furnace No. 3A, the final five-ribbon demonstration run was performed. The furnace performed nearly flawlessly over the 15 hour run during which ~ 30 meters of 5 cm wide ribbon were grown at a rate of ~ 3.3 cm/min from each of the five cartridges. Initial evaluation of a small lot of 45 cm^2 solar cells of ~ 9% (AM1) efficiency. Subsequent to this final multiple demonstration run, the furnace was converted to be operated with three 10 cm width cartridges, plus a melt replenishment unit. This conversion is now complete, and the first growth runs using one cartridge and the melt replenisher have produced ~ 4 meters of 10 cm wide ribbon at a growth rate of 3.5 cm/min. In Furnace 17, work on stress has continued, and a basic investigation of stress and buckle generation in the ribbon has shown this to be a fairly complex problem at high growth rates. However, at rates up to perhaps 5 cm/min, the problem may be manageable through improvements in puller design and ribbon guidance. Also on this machine, the work with automatic control designs is making progress, and in an appendix to this report, a very comprehensive discussion of the control dynamics during EFG growth is provided.

13261 (DOE/JPL/954471—11) **Novel duplex vapor-electrochemical method for silicon solar cells. Quarterly progress report No. 14, May 1-July 31, 1979.** Nanis, L.; Sanjurjo, A.; Sancier, K. (SRI International, Menlo Park, CA (USA)). 31 Aug 1979. Contract NAS-7-100-954471. 20p. Dep. NTIS, PC A02/MF A01.

Current work on the reaction between gaseous SiF_4 and solid Na has proceeded with the following objectives: (1) obtain data needed for plant design by scaling up the reaction to produce greater amounts of reaction product; (2) increase reaction rate and overall Si production rate; (3) increase the efficiency of the reaction so that less unreacted Na and less Na_2SiF_6 are produced; and (4) produce large amounts of reaction product for use in studies of Si recovery by melt separation. The SiF_4-Na reaction system has been scaled up to a reactor i.d., of 13 cm; the capacity of the Na chip feeder has also been increased. The system can now produce 5-kg batches of reaction product (mixed Si and NaF) at a production rate of 1.2 kg Si per hour. The melt-separation system has been modified to routinely melt 5-kg batches of mixed reaction product fed in a continuous mode at a production rate of 0.5 kg Si per hour. Support studies of Si coalescence show NaOH may be added to the NaF melt in amounts up to 5 wt % before there is any tendency for the Si to form large drops rather than a single pool. (WHK)

13262 (DOE/JPL/954521—10) **Integral glass encapsulation for solar arrays. Quarterly progress report No. 10.** (Spire Corp., Bedford, MA (USA)). Jun 1979. Contract NAS-7-100-954521. 18p. Dep. NTIS, PC A02/MF A01.

This is the tenth quarterly report under a JPL/DOE program for the development of permanent, integral glass encapsulation of terrestrial solar photovoltaic arrays by electrostatic bonding (ESB). The goal of this program is to develop electrostatic bonding to the point of being a cost-effective, practical, and automatable process that can be employed for large-scale production of arrays with lifetimes of more than 20 years. Electrostatic bonding is a technique for forming permanent bonds between silicon (or other materials) and glass, without the use of adhesives. The bond is formed quickly and, once formed, can be stronger than either of the materials being joined. The inherent strength of the seal makes this an extremely durable encapsulation method, and the simplicity of the process makes it suitable for automation. Economic analyses have shown that electrostatic bonding can meet the 1986 LSA price goals. Two basic types of electrostatically bonded modules were demonstrated during Phase II of this program, both based on an integral glass superstrate assembly. A number of conventional backings can be used to complete the encapsulation, or a back glass can be attached by electrostatic bonding for ultimate durability. Both module types have proved their reliability in accelerated environmental testing. In the present program phase, these fundamental designs will be scaled up to a larger size - to the maximum possible using existing equipment - and routine, consistent module production will be demonstrated.

13263 (DOE/JPL/954589—8) **Development of a process for high capacity arc heater production of silicon for solar arrays. Quarterly technical report, October 1978-February 1979.** Fey, M.G. (Westinghouse Electric Corp., Trafford, PA (USA). Power Circuit Breaker Div.). 1979. Contract NAS-7-100-954589. 102p. Dep. NTIS, PC A06/MF A01.

A program has been established at Westinghouse to develop a high temperature silicon producton process using existing electric arc heater technology. Silicon tetrachloride and a reductant (sodium) will be injected into an arc heated mixture of hydrogen and argon. Under these high temperature conditions, a very rapid reaction is expected to occur and proceed essentially to completion, yielding silicon and gaseous sodium chloride. Techniques for high temperature separation and collection of the molten silicon will be developed using standard engineering approaches, and the salt vapor will later be electrolytically separated into its elemental constituents for recycle. Preliminary technical evaluations and economic projecctions indicate not only that this process appears to be feasible, but that it also has the advantages of rapid, high capacitty production of good quality molten silicon at a nominal cost. The program involves a multi-task approach including (1) a detailed engineering analysis of the entire process (2) design, fabrication, and assembly of the experimental system (3) experimental testing of the reduction reaction to produce silicon and (4) complementary research programs to augment the experimental system design. The status of the project is described in detail. (WHK)

13264 (DOE/JPL/954847—4) **Phase 2 of the automated array assembly task of the Low-Cost Silicon Solar Array Project. Annual report.** Coleman, M.G.; Grenon, L.P.; Pastirik, E.M.; Pryor, R.A.; Sparks, T.G. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). Nov 1978. Contract NAS-7-100-954847. 212p. Dep. NTIS, PC A10/MF A01.

This report presents the results of investigations and analyses of an advanced process sequence for manufacturing high efficiency solar cells and modules in a cost-effective manner. The entire process sequence is presented and discussed step by step. Emphasis is on process simplicity and minimizing consumed materials. The process sequence incorporates texture etching, plasma processes for damage removal and patterning, ion implantation, low pressure silicon nitride deposition, and plated metal. A reliable module design is presented. Specific process step developments are presnted. Further, a detailed cost analysis has been performed to indicate future areas of fruitful cost reduction effort. Finally, recommendations for advanced investigations are presented.

13265 (DOE/JPL/954862—7) **Development of a model and computer code to describe solar grade silicon production processes. Seventh quarterly report, April 1-June 30, 1979.** Srivastava, R.; Gould, R.K. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Aug 1979. Contract NAS-7-100-954862. 18p. (AeroChem-TN—207). Dep. NTIS, PC A02/MF A01.

This program aims at developing mathematical models and computer codes based on these models, which allow prediction of the product distribution in chemical reactors for converting gaseous silicon compounds to condensed-phase silicon. The major interest is in collecting silicon as a liquid on the reactor walls and other collection surfaces. Two reactor systems are of major interest, the Westinghouse $SiCl_4$/Na reactor in which Si(l) is collected on the flow tube reactor walls and the new AeroChem reactor in which Si(l) droplets formed by the $SiCl_4$/Na reaction are collected by a jet impingement method. During this quarter the following tasks have been accomplished: (1) particle deposition routines have been added to the boundary layer code and (2) Si droplet sizes in $SiCl_4$/Na reactors at temperatures below the dew point of Si are being calculated. Initial results from the latter show that droplet sizes in such reactors are predominantly in the range 0.2 to 1.0 μm. Such particles are too small to collect by conventional means (e.g., cyclones) but should be easily collected by very high velocity impaction at reduction pressures such as that being examined by AeroChem.

13266 (DOE/JPL/954873—7) **Phase 2 of the Array Automated Assembly Task for the Low Cost Solar Array Project. Quarterly report No. 7, April 1-June 30, 1979.** Campbell, R.B.; Rai-Choudhury, P.; Seman, E.J.; Rohatgi, A.; Davis, J.R.; Ostroski, J.W.; Stapleton, R.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 5 Sep 1979. Contract NAS-7-100-954873. 24p. Dep. NTIS, PC A02/MF A01.

The major objective of this program is to define and verify a process sequence for the fabrication of solar cell modules from dendritic web silicon. Another objective is the development of key process steps. The process sequence and the individual steps must be amenable to automation and low cost manufacturing methods so that the target selling price of $0.70/watt peak (1980$ in 1986) can be achieved. Two process specifications supplied by other contractors have been tested. The Al Silk Screening Process by Spectrolab resulted in cells comparable to those from sputtered Al. The electroless plating of contacts specification supplied by Motorola could be

used only with extensive modification. Several experiments suggest that there is some degradation of the front junction during the Al BSF formation. A SAMICS cost analysis of this process yielded a selling price of $0.75/watt peak in 1980$.

13267 (DOE/JPL/954882—19) **Process development for automated solar cell and module production. Task 4. Automated array assembly. Quarterly report No. 4.** Hagerty, J.J. (MB Associates, San Ramon, CA (USA)). 15 Oct 1979. Contract NAS-7-100-954882. 24p. (MB-R—79/98). Dep. NTIS, PC A02/MF A01.

Construction of the components of an automated solar cell layup and interconnect system is now complete. This system incorporates a Unimate 2000 B industrial robot with an end effector consisting of a vacuum pick up and induction heating coil. The robot interfaces with a smart cell preparation station which correctly orients the cell, applies solder paste and forms and positions the correct lengths of interconnect lead. The system is controlled and monitored by a TRS-80 micro computer. The entire system is presently undergoing integration prior to formal testing. A survey of elastomer manufacturers has shown transfer molded EPDM to be a strong candidate for the edge sealing material.

13268 (DOE/JPL/954886—7) **LSA large area silicon sheet task continuous liquid feed Czochralski growth. Quarterly report No. 6, January-March 1979.** Walters, D. (Siltec Corp., Menlo Park, CA (USA)). Apr 1979. Contract NAS-7-100-954886. 32p. Dep. NTIS, PC A03/MF A01.

Siltec Corporation's contract with JPL is directed towards the design and development of equipment and processes, to demonstrate continuous growth of crystals by the Czochralski method, suitable for producing single silicon crystals for use in solar cells. Continuous growth is defined as the growth of 100 kg of single silicon crystal, 10 cm in diameter, from one container. Siltec's approach to meeting this goal is to develop a furnace with continuous liquid replenishment of the growth crucible, accomplished by a meltdown system and a liquid transfer mechanism, with associated automatic feedback controls. Several test runs were performed during the final quarter of Phase I with the main aim of achieving 100 kg of ingot growth from one container. The best results accomplished during these demonstration runs were 70 kg of ingot produced in 70 hours. Problems and experience are reported.

13269 (DOE/JPL/955089—4) **Silicon solar cell process development, fabrication and analysis. Phase I. Annual report, June 15, 1978-June 15, 1979.** Yoo, H.I.; Iles, P.A.; Tanner, D.P. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1979. Contract NAS-7-100-955089. 178p. Dep. NTIS, PC A09/MF A01.

This program has investigated, developed and utilized technologies appropriate and necessary for improving the efficiency of solar cells made from various unconventional silicon sheets. During this reporting period, work has progressed in fabrication and characterization of solar cells from RTR ribbons (Motorola), EFG (RF and RH) ribbons (Mobil-Tyco), dendritic webs (Westinghouse), Silso wafers (Wacker), cast silicon by HEM (Crystal Systems), silicon on ceramic (Honeywell) and continuous Czochralski ingots (Hamco). Solar cells were fabricated using a standard process typical of those used currently in the silicon solar cell industry. Also back surface field (BSF) processing and other process modifications were included to give preliminary indications of possible improved performance. The parameters measured included open circuit voltage, short circuit current, curve fill factor, and conversion efficiency (all taken under AMO illumination). Also measured for typical cells were spectral response, dark I-V characteristics, minority carrier diffusion length, and photoresponse by fine light spot scanning. The results were compared to the properties of cells made from conventional single crystalline Czochralski silicon with an emphasis on statistical evaluation. Limited efforts were made to identify growth defects which will influence solar cell performance and discussion is given on the difficulties experienced in processing the sheets using near-conventional methods.

13270 (DOE/JPL/955131—1) **Development of methods of producing large areas of silicon sheet by the slicing of silicon ingots using inside diameter (ID) saws. First quarterly report.** Aharonyan, P. (Silicon Technology Corp., Oakland, NJ (USA)). 1979. Contract NAS-7-100-955131. 24p. Dep. NTIS, PC A02/MF A01.

An STC 16 inch automated ID slicing machine (Model SMA-4401) is being used for this effort. The saw has been modified to accept an STC Programmable Electric Feed System, STC Crystal Rotating System and an STC Dyna-Track Blade Monitoring and Control System. The saw and accessories will be used to slice 100 mm diameter single crystal silicon ingots while rotating them. The automated saw will automatically recover the wafers and load them into a cassette. The amount of material lost during slicing is being reduced by using smaller blades than ones normally used to slice 100 mm wafers. Some blades have been manufactured with cutting edge thickness as low as 0.20 mm. Initial slicing runs on 75 mm diameter silicon has been successful on blades in the 0.23 to 0.24 mm cutting edge thickness range. The thinner blades will be used to slice 100 mm silicon while rotating the boule.

13271 (DOE/JPL/955266—1) **Automated array assembly task: in-depth study of silicon wafer surface texturizing. Quarterly technical report No. 1, December 14, 1978-March 31, 1979.** Jones, G.T.; Chitre, S.; Rhee, S.S.; Allison, K.L. (Sensor Technology, Inc., Chatsworth, CA (USA)). Mar 1979. Contract NAS-7-100-955266. 49p. Dep. NTIS, PC A03/MF A01.

Four tasks were investigated in this program. Identification of Freon recycling as a low-cost wafer cleaning method was made. An ultrasonic vapor degreaser that utilizes the Freon recycling technique was ordered. Equipment was acquired to produce clean dry air. It was concluded that the low cost clean dry air system can replace the high cost dry nitrogen system without any adverse effects in the solar cell electrical performance. The texturizing process time in large scale production was found to be variable when chemical concentrations and temperatures in the two stage texturizing process were held constant. The introduction of a low temperature intermediate gettering step in combination with a two stage texturizing process sequence was shown to produce a large improvement in solar cell efficiencies. Gettering improved the quality of silicon wafer material. Experimental results also showed that gettering improved the electrical performance of spray-on doped solar cells. Sensor Technology's standard production process utilizing the gettering treatment produced an average batch efficiency of 13.3%. The highest solar cell efficiency obtained from this batch was 14.3%.

13272 (DOE/JPL/955270—2) **Low cost Czochralski crystal growing technology. Near term implementation of the flat plate photovoltaic cost reduction of the Low Cost Solar Array Project. Second quarterly progress report, July 1-September 30, 1979.** Roberts, E.G. (Kayex Corp., Rochester, NY (USA)). 1979. Contract NAS-7-100-955270. 13p. Dep. NTIS, PC A02/MF A01.

During the quarterly reporting period, the R.F. induction heating generator and the contractor-owned CG2000 RC crystal puller have been received and are currently being installed. Installation is approximately 90% complete. Completion is scheduled for October 3, 1979. All functions of the crystal grower have been tested out and a 7 kilogram crystal has been pulled in the equipment testing department as part of a standard customer acceptance analysis. Total redesign of the crystal recharge system has been completed and the fabrication has been subcontracted. Problems interfacing the R.F. work coil with the R.F. feed-thru system has necessitated a redesign of the coil connection assembly. This is scheduled for completion October 10, 1979. The R.F. feed-thru has been redesigned due to extensive lead times for specialized materials. The system is currently being fabricated in-house. The redesign now allows us to utilize the spectator viewport for the feed-thru rather than having to machine the port in the tank cover assembly. All necessary piece parts for crystal growth have been received, together with 159 kilograms of nominally 5" diameter polycrystalline silicon rod. A quotation has been received for fabrication of the cold crucible assembly and work coil. This is currently being evaluated.

13273 (DOE/JPL/955282—1) **LSA large area silicon sheet task enhanced ID slicing technology for silicon ingots. Quarterly report, February-March 1979.** Walters, D. (Siltec Corp., Menlo Park, CA (USA)). Apr 1979. Contract NAS-7-100-955282. 21p. Dep. NTIS, PC A02/MF A01.

Efforts to make ingot technology cost effective for the production of low cost solar cells in the 1980-1986 timeframe have been divided into both the development of a continuous CZ growth process and advanced ingot slicing. While continuous CZ growth is being extensively explored with very promising results, very little work has been directed towards technological improvements of I.D. slicing - the primary shortcoming of ingot technology. The direction of this program is aimed towards the development and demonstratin of enhanced I.D. slicing technology that will significantly increase the number of useable slices per inch of crystal over industry practice. This method will require a reduction of both blade and slice thickness. It will be accomplished by a combination of three key elements of slicing technology: ingot rotation with minimum exposed blade area, dynamic cutting edge control, and the use of prefabricated insert blades. During the first quarter, design modifications were initiated on a Siltec slicing saw, Model E-1, with microprocessor controls. Hardware, to complete this conversion, is being fabricated. Several runs were conducted on the engineering saw incorporating the method of ingot rotation. Ingots with diameters up to 6 inches were sliced successfully on a production saw.

13274 (DOE/JPL/955282—79/2) **LSA large area silicon sheet task enhanced I.D. slicing technology for silicon ingots. Quarterly report No. 2, April-June 1979.** Walters, D. (Siltec Corp., Menlo Park, CA (USA)). Jul 1979. Contract NAS-7-100-955282. 26p. Dep. NTIS, PC A02/MF A01.

Efforts to make ingot technology cost effective for the production of low cost solar cells in the 1980 to 1986 timeframe have been divided into both the development of a continuous CZ growth

process and advanced ingot slicing. The direction of this program is aimed towards the development and demonstration of enhanced I.D. slicing technology that will significantly increase the number of usable slices per inch of crystal over industry practice. This method will require a reduction of both blade and slice thickness. It will be accomplished by a combination of three key elements of slicing technology: ingot rotation with minimum exposed blade area, dynamic cutting edge control, and the use of prefabricated insert blades. The development of cutting ingots with ingot rotation requires several design modifications of a Siltec slicing saw, Model E-1, with microprocessor controls. All necessary design changes under the plan are completed, and the fabrication of hardware has begun. A demonstration of ingot cutting with rotation was performed. Wafers produced were 10 cm in diameter, 250 μ thick with a standard kerf of 250 and 305 μ. Difficulties with decreasing kerfs were encountered. A conceptual design of cutting edge control devices, supported by experimental data, was completed. A number of cutting inserts with various parameter variations are presently manufactured. Bonding tests for core and insert materials in static and dynamic conditions are performed.

13275 (DOE/JPL/955287—3) **Automated solar module assembly line. Quarterly technical report No. 3.** Bycer, M. (Kulicke and Soffa Industries, Inc., Horsham, PA (USA)). Sep 1979. Contract NAS-7-100-955287. 32p. Dep. NTIS, PC A03/MF A01.

Progress during this period includes the work performed in bonding interconnects with induction and pulsed heating, and prototype designs for the conveyor, theta orient station, and vacuum pick-up and lance assemblies. The machine which Kulicke and Soffa is to deliver under this contract is a cell stringing and string applique machine which will be flexible in design, capable of handling a variety of cells and assembling strings of cells which can then be placed in a matrix up to 2' 4' in series or parallel arrangement. The target machine cycle is to be 5 seconds per cell. This machine will be preimarily adapted to 3 inch diameter round cells with one or two tabs between cells. The design of the machine will be flexible so that it can be modified to handle other cell sizes, string lengths and module arrangements. The solar cells to be delivered for performance tests on the equipment to be delivered are 3 inch diameter commercially available cells of high quality. The bonding interconnect technique to be utilized is pulsed heat technology.

13276 (DOE/JPL/955298—1) **High resolution, low cost solar cell contact development. Quarterly technical progress and schedule report, quarter ending August 24, 1979.** Mardesich, N. (Spectrolab, Inc., Sylmar, CA (USA)). 21 Sep 1979. Contract NAS-7-100-955298. 21p. Dep. NTIS, PC A02/MF A01.

Experimental work to demonstrate the feasibility of the MIDFILM process as a means of applying solar cell collector metallization has been conducted during this quarter. The MIDFILM process attains a line resolution characteristic comparable to photoresist methods with a process related to screen printing. The surface to be processed is first coated with a thin layer of photoresist material. Upon exposure to ultraviolet light through a suitable mask, the resist in the non-pattern area cross-links and becomes hard. The unexposed pattern areas remain tacky. The conductor material is applied in the form of a dry mixtture of metal and frit particles which adhere to the tacky pattern area. The assemblage is then fired to ash the photopolymer and sinter the fritted conductor powder. Five silver powder conproduced comparable performance to screen printed paste, which was used as a control. (WHK)

13277 (DOE/JPL/955307—2) **Analysis of the effects of impurities in silicon. Second quarterly report, May 1-July 31, 1979.** Wohlgemuth, J.H.; Lafky, W.M.; Burkholder, J.H. (Solarex Corp., Rockville, MD (USA)). 1979. Contract NAS-7-100-955307. 44p. Dep. NTIS, PC A03/MF A01.

The purpose of this program is to conduct a solar cell fabrication and analysis program to determine the effects on the resultant solar cell efficiency of impurities intentionally incorporated into silicon. The program will employ flight-quality technologies and quality assurance to assure that variations in cell performance are due to the impurities incorporated in the silicon. Efforts included (1) completion of the processing of verification cells to assure proper process control and to serve as a data base for all future experimental work, (2) study of the dependance of cell performance on crystal orientation to aid in evaluation of the 111 test wafers and (3) completion of the first 5 test runs and analysis of their performance. The verification runs resulted in an average AMO cell efficiency of 12.9% at 25°C (in excess of 15% AMI at 25°C). The average test lot efficiency has varied from 10.6 to 12% at AMO and 25°C. The first 5 test lots have shown a large variation in bulk resistivity (0.2 Ω-cm up to 3.8 Ω-cm) resulting in large variations in lot open circuit voltage (561 mV to 610mV) as would be expected for doping with any active species. The presence of grains boundaries in several wafers had no effect on cell electrical performance. All monitor and control runs to date have cell performance characteristics indistinguishable from the verification runs indicating no contamination. The type and level of impurity doping in each test lot is given and the mechanism responsible for the degradation of cell performance has been identified and correlated to the doped impurities.

13278 (DOE/JPL/955325—1) **Vacuum die casting of silicon sheet for photovoltaic applications. First quarterly report, March 16-June 30, 1979.** (ARCO Solar, Inc., Chatsworth, CA (USA)). 1979. Contract NAS-7-100-955325. 31p. Dep. NTIS, PC A03/MF A01.

The obtective of this program is to develop a vacuum die-casting process for producing silicon sheet suitable for photovoltaic cells and to develop production techniques for optimization of polycrystallie silicon solar cell output. Efforts will examine process methods which are directed toward minimum cost processing of silicon into a quality suitable for producing solar cells with a terrestrial efficiency greater than 12% and having the potential to be scaled for large quantity production. In the vacuum die casting technique, silicon is melted under vacuum, and an evacuated die with a thin rectangular cavity is inserted into the melt. Liquid silicon is then injected into the die using a positive pressure of an inert gas. The major portion of the die casting work will be performed at Stanford Research Institute International under subcontract. The initial approach will follow parallel tracks: (1) obtain mechanical design parameters by using boron nitride, which has been shown to be non-wetting to silicon; (2) optimize silicon nitride material composition and coatings by sessile drop experiments; (3) test effectiveness of fluoride salt interfacial media with a graphite mold; and (4) test effect of surface finish using both boron nitride and graphite. Having established the material and mechanical boundary conditions, a finalized version of the prototype assembly will be constructed and the casting varibles determined. Polycrystalline silicon solar cells, with and without impurities, will be fabricated, characterized, and optimized at ARCCO Solar. The major activities will focus on the use of Wacker SILCO, HEM and in-house materials until vacuum die cast wafers are available. A baseline process with vacuum metallized contacts will be established and a reference mass production process with screen-printed metallization and high-throughput diffusions will also be obtained.

13279 (DOE/JPL/955387—1) **Anti-reflection coatings applied by acid leaching process. Quarterly technical report No. 1, April 1-June 31, 1979.** Pastirik, E. (Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group). 1979. Contract NAS-7-100-955387. 13p. Dep. NTIS, PC A02/MF A01.

Progress during the first three months of a nine-month program to study the production of anti-reflective coatings for glass solar module covers by means of a silica-saturated fluosilicic acid etch is reported. The efforts of the program during this first quarterly period have been to set up the process and begin production of filmed sample glass plates. To this end, a temperature-controlled bath has been prepared, large quantities of the filming solution have been formulated, and production of samples has begun using empirically determined processes. (WHK)

13280 (DSE—3412-T2) **Photovoltaic mechanisms in polycrystalline thin-film solar cells. Quarterly technical progress report No. 2, January 27-April 27, 1979.** Zanio, K. (Hughes Aircraft Co., Malibu, CA (USA)). Aug 1979. Contract ET-78-C-01-3412. 16p. Dep. NTIS, PC A02/MF A01.

Indium phosphide films were prepared at reduced temperatures on InP by the planar reactive deposition technique. For substrate temperatures as low as 260°C and growth rates of 1 μm/h, single-crystal epitaxy was obtained on (100) semi-insulating substrates. These results are preliminary steps in the process of achieving clean polycrystalline layers and preparing p-n junctions containing grain boundaries. In parallel studies to eventually passivate grain boundaries by etching beyond the p-n junction to form isolated single-crystal mesa structures, a 3 HNO_3:HCl etch was found to preferentially attack selected InP grain boundaries and produce grooves.

13281 (DSE—4042-T5) **Cadmium sulfide/copper sulfide heterojunction cell research. Quarterly technical progress report, February 26-May 31, 1979.** Thornton, J.A. (TELIC Corp., Santa Monica, CA (USA)). 31 Jul 1979. Contract EG-77-C-01-4042. 35p. Dep. NTIS, PC A03/MF A01.

All-vacuum sputter deposited heterojunction solar cells of the CdS/Cu_2S and Cd/sub 1-x/Zn/sub x/S/Cu_2S types have been fabricated on glass substrates by dc reactive sputtering using cylindrical-post magnetron sputtering sources and Ar-H_2S working gases. The rear electrode is Nb. The top grid electrode is Au sputter deposited through a mechanical mask. Preliminary measurements on nonoptimized cells have yielded efficiencies of about 0.4% with short circuit currents of about 3 mA/cm^2, open circuit voltages of about 0.35V and fill factors of about 0.37. Extensive modifications are being made to the deposition apparatus which will permit greater control over the process variables and optimization of the cells. A series of experiments are reported which indicated that at the high deposition temperatures used for the Cd(Zn)S deposition ($\sim$ 300°C), an electrically active impurity, capable of influencing both the series resis-

tance and the junction behavior of the cells, may pass from the Nb into the Cd(Zn)S.

13282 (DSE—4042-T14) **Cadmium sulfide/copper ternary heterojunction cell research. Second quarterly technical progress report, June 1-August 31, 1979.** Mickelsen, R.A.; Chen, W.S.; Wei, P.S.P.; Buldhaupt, L.F. (Boeing Aerospace Co., Seattle, WA (USA)). Oct 1979. Contract EG-77-C-01-4042. 24p. Dep. NTIS, PC A02/MF A01.

The preparation of $CuInSe_2$ thin films by simultaneous elemental evaporation is reported to be more reproducible with the application of Electron Impact Emission Spectroscopy (EIES) for deposition rate control. Rapid diffusion processes occurring at the high substrate temperatures are described as precluding the use of thick selenide layers highly deficient in In as part of the cell structure. Growth of cell degrading copper nodules in low resistivity, P-type $CuInSe_2$ films exposed to CdS is discussed. A point defect model for the vacuum deposited $CuInSe_2$ cells is discussed and demonstrate the repeatable achievement of 2 to 5% efficient cells. These cells are described as possessing high photocurrents (25-34mA/cm^2) and low open circuit voltages (150-310mV) when tested under simulated AM-1 conditions. Detailed analysis of cells as a function of temperature and lighting conditions is described. The cell measurements are reported to be in good agreement with a cell model and indicate that the low voltage is caused by a high resistivity selenide layer at the junction.

13283 (DSE—23047-T1) **Thin film polycrystalline silicon solar cells. Quarterly report No. 1, January 1, 1979-March 31, 1979.** Ghosh, A.K.; Feng, T.; Maruska, H.P.; Fishman, C. (Exxon Research and Engineering Co., Linden, NJ (USA)). 1979. Contract AC02-79ET23047. 47p. Dep. NTIS, PC A03/MF A01.

A theory capable of predicting the performance of polycrystalline silicon solar cells is formulated. It relates grain size to mobility, lifetime, diffusion length, reverse saturation current, open circuit photovoltage and fill factor. Only the diffusion lengths measured by the surface photovoltage technique for grains $\leqq$ 5 μm do not agree with our theory. The reason for this discrepancy is presently being investigated. We conclude that grains $\geqq$ 100 μm are necessary to achieve efficiencies $\geqq$ 10 percent at AM1 irradiance. The calculations were performed for the case of no grain boundary passivation. At present we are investigating the improvements to be expected from grain boundary passivation. We have determined that the parameters that best fit the available data are as follows: (1) Number of surface states at grain boundaries acting as recombination centers - 1.6 x 10^{13}/cm^2. (2) Capture cross section - 2 x 10^{-16} cm^2. (3) Surface recombination velocity at grain boundary - 3.2 x 10^4 cm/sec. The following types of solar cells are considered in the model: SnO_2/Si Heterostructure, MIS, and p/n junction. In all types of solar cells considered, grain boundary recombination plays a dominant role, especially for small grains. Though the calculations were originally expected to yield only order of magnitude results, they have proven to be accurate for most parameters within 10 percent.

13284 (N—79-22625) **Long-term temperature effects on gaas solar cells. Final report, 1 January 1978-15 April 1979.** Heinbockel, J.H.; Hong, K.H. (Old Dominion Univ. Research Foundation, Norfolk, VA (USA). Dept. of Mathematical and Computing Sciences). Apr 1979. 61p. NTIS PC A04/MF A01.

The thermal degradation of AlGaAs solar cells resulting from a long-term operation in a space environment is investigated. The solar cell degradation effects caused by zinc and aluminum diffusion as well as deterioration by arsenic evaporation are presented. Also, the results are presented of experimental testing and measurements of various GaAs solar cell properties while the solar cell was operating in the temperature range of 27 C to 350 C. In particular, the properties of light current voltage curves, dark current voltage curves, and spectral response characteristics are given. Finally, some theoretical models for the annealing of radiation damage over various times and temperatures are included.

13285 (N—79-22630) **Characterization of solar cells for space applications. volume 5: electrical characteristics of OCLI 225-micron mlar wraparound cells as a function of intensity, temperature, and irradiation.** Anspaugh, B.E.; Miyahira, T.F.; Weiss, R.S. (Jet Propulsion Lab., Pasadena, CA (USA)). 1 Apr 1979. Contract NAS7-100. 64p. NTIS PC A04/MF A01.

Computed statistical averages and standard deviations with respect to the measured cells for each intensity temperature measurement condition are presented. Display averages and standard deviations of the cell characteristics in a two dimensional array format are shown: one dimension representing incoming light intensity, and another, the cell temperature. Programs for calculating the temperature coefficients of the pertinent cell electrical parameters are presented, and postirradiation data are summarized.

13286 (N—79-26497) **Process development for automated solar cell and module production. task 4: automated array assembly. Annual report.** (MB Associates, San Ramon, CA (USA)). 12 Jun 1979. Contract JPL-954882. 128p. NTIS, PC A07/MF A01.

A baseline sequence for the manufacture of solar cell modules was specified. Starting with silicon wafers, the process goes through damage etching, texture etching, junction formation, plasma edge etch, aluminum back surface field formation, and screen printed metallization to produce finished solar cells. The cells were then series connected on a ribbon and bonded into a finished glass tedlar module. A number of steps required additional developmental effort to verify technical and economic feasibility. These steps include texture etching, plasma edge etch, aluminum back surface field formation, array layup and interconnect, and module edge sealing and framing.

13287 (N—79-26506) **An investigation of the adhesive bonding of Teflon solar cell covers.** Rayl, G.J. (General Electric Co., Philadelphia, PA (USA). Space Div.). 30 Apr 1979. Contract NAS3-21264. 42p. NTIS, PC A03/MF A01.

The concept of introducing organic agents into silicone resins to stabilize these materials against the ravages of ultraviolet radiation is presented. A screening of coating materials, cover materials and ultraviolet screening agents is described. Fabrication processes were developed for the application of thin 25 micrometer coatings to Teflon. Temperature shock and temperature-humidity tests were conducted.

13288 (SAN—1876-3) **Thin-film polycrystalline silicon solar cells. Quarterly report No. 3, 11 March 1979-10 June 1979.** Faughnan, B.W. (RCA Labs., Princeton, NJ (USA)). Jul 1979. Contract ET-78-C-03-1876. 37p. Dep. NTIS, PC A03/MF A01.

A total of 12 solar cells were fabricated this quarter; half had diffused junctions and half had ion-implanted junctions. Detailed quantum efficiency measurements were made on two of the cells, both inside a single grain and across several grains. The reduction of J/sub sc/ in going from a single crystal to a Wacker polycrystalline substrate is 6 to 8% due to bulk properties and 4 to 7% due to grain boundary effects. Laser scans were made at λ = 1.15 μm which showed greatly enhanced photo-response dips. Linewidths of the dips varied from 50 to 280 μm depending on the cell. Electron channel patterns were determined for ten grains. No major crystallographic orientations were found, and some grains had an almost twin relationship.

13289 (SAN—2219-3) **Amorphous thin films for solar-cell applications. Quarterly report No. 3, 12 April 1979-11 July 1979.** Carlson, D.E.; Balberg, I.; Crandall, R.S.; Goldstein, B.; Hanak, J.J.; Pankove, J.I.; Staebler, D.L. (RCA Labs., Princeton, NJ (USA)). Jul 1979. Contract ET-78-C-03-2219. 109p. Dep. NTIS, PC A06/MF A01.

A theory for the capture of electrons by deep centers in hydrogenated amorphous silicon (a-Si:H) is presented. In the section on deposition and doping studies, some recent results obtained with the rf magnetron deposition system are described. Other results show that additions of Ar to dc or ac SiH_4 discharges cause the dark conductivity and photoconductivity to increase. Other data show that the addition of SiF_4 to SiH_4 discharges cause the photoluminescence intensity to decrease. In the section on experimental methods for characterizing a-Si:H, recent work involving photoconductivity spectra, the photoelectromagnetic effect, and the Hall effect in undoped a-Si:H is briefly described. Preliminary data on the photo-Hall effect indicates mobilities in the range of 1 to 13 cm^{2}V^{-1}S^{-1} for electrons and 0.1 to 2.5 cm^{2}V^{-1}S^{-1} for holes. Measurements of the surface photovoltage have been used to estimate the distribution of surface states on a-Si:H. Tunneling measurements have also been used to characterize the surface and bulk states in MIS junctions. A new technique for determining the optical absorption in the band-tail states in a-Si:H is described. Information on stacked or multiple-junction a-Si:H solar cells and on large-area, series-connected cells is given. In the section on theoretical and experimental evaluation of solar-cell parameters, the influence of photoconductive gain on the fill factor of a-Si:H cells is discussed, and an upper limit of $\sim$ 380 A is established for the hole diffusion length in a-Si:H films made in an rf capacitive discharge. Some characteristics of Pd-Schottky-barrier cells for different processing histories are presented.

13290 (SAND—79-2345A) **Distributed automatic test system for characterizing photovoltaic arrays.** Verardo, A.E. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 9p. (CONF-800109—1). Dep. NTIS, PC A02/MF A01.

From ATE seminar/exhibit and test instruments conference; Pasadena, CA, USA (7 Jan 1980).

The automatic test system which is currently in use at the Advanced Concepts Photovoltaic Test Facility located at Sandia Laboratories in Albuquerque, New Mexico, is described. The equipment was designed to test various types of photovoltaic modules and arrays, as well as evaluate and operate all components of a complete photovoltaic power generation system. The test system uses a Hewlett Packard 21MX series minicomputer as the central processor and main controller. The main processor controls the bulk of the system

mass storage devices which include a 5 megabyte and 20 megabyte disc and two 9 track magnetic tape recorders. The main processor also has data acquisition and control equipment. The main processor communicates with most of this equipment via an IEEE-488 bus. The main processor monitors the facility operation and the weather instrumentation, and it conducts tests on the large scale systems. (WHK)

13291 (SAND—80-0112C) **Qualification testing of photovoltaic concentrator modules for system application experiments.** McDowell, J.F.; Pritchard, D.A.; Verardo, A.E. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 14p. (CONF-800106—12). Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

Concentrator module performance qualification testing at Sandia Laboratories is described. The nature of the qualification tests, the control and data acquisition systems used and typical performance data on representative modules are discussed. Qualification testing is to be performed on modules assembled by final production processes and is designed to identify design/construction weaknesses rather than measure life expectancy. Three trackers will be used as will three independent computer-controlled data acquisition systems. The basic elements are the computer, control equipment, data acquisition instruments, a portable thermal loop, and programmable electronic load.

13292 (SAND—80-0170C) **Low-cost, high-performance, point-focus concentrator array design.** Shafer, B.D.; Edenburn, M.W.; Garner, M.; Togami, H. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 12p. (CONF-800106—19). Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

The design and fabrication of optimized photovoltaic concentrator arrays has been initiated which are meant to demonstrate the technology readiness of actual hardware for the 1980 goal of $2.80/Wp. Two basic approaches are being pursued in parallel. These are a point-focus Fresnel lens concept, and a linear-focus parabolic trough. The point-focus design is presented. The basic approach has been to meld together the best features of a number of designs done previously. These have been combined with extensive analysis, and some innovations to produce a design which will permit demonstration of the 1980 goal in terms of price, hardware performance, durability, and reliability.

13293 **Solar array strip and a method for forming the same.** Mueller, R.L.; Yasui, R.K. US Patent 4,133,697. 9 Jan 1979. Filed date 24 Jun 1977. 7p.

A flexible solar array strip is formed by providing printed circuitry between flexible layers of a nonconductive material, depositing solder pads on the printed circuitry, and storing the resulting substrate on a drum from which it is then withdrawn and advanced along a linear path. Solderless solar cells are serially transported into engagement with the pads and are infrared radiation to melt the solder and attach the cells to the circuitry. Excess flux is cleaned from the solar cells which are then encapsulated in a protective coating. The resulting array is then wound on a drum.

13294 **Research issues for low cost photovoltaic cells.** Burke, J.R.; Feucht, D.L. (Solar Energy Research Inst., Golden, CO). pp 624-630 of 2nd E.C. photovoltaic solar energy conference. Van Overstraeten, R.J.; Palz, W. (eds.). Hingham, MA; D. Reidel Publishing Co. (1979).

From 1979 photovaltaic solar energy conference; West Berlin, F.R. Germany (23 Apr 1979).

The long term goal of the US Photovoltaic Program is solar to electrical energy conversion at a cost of 10-30 cents per peak watt. Two approaches offer promise of meeting this goal. One would make use of solar cells employing thin films of polycrystalline or amorphous semiconductors on low cost substrates. The photovoltaic conversion efficiency requirement of 10% or greater dictates however that such materials must have electronic properties that are not drastically degraded from those of their single crystal counterparts. The other approach would incorporate solar concentration and either moderate efficiency (10%) luminescent cells or high technology, high efficiency (30%) multibandgap cells. Some of the fundamental investigations that are needed to examine the efficiency potential of each of these approaches are outlined.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 13205, 13206, 13207, 13208, 13209, 13210, 13211, 13212, 13213, 13216, 13217, 13218, 13219, 13220, 13221, 13222, 13223, 13224, 13225, 13227, 13369, 13504, 13718, 13745, 13746, 13748, 13749, 13750, 13751

13295 (CONF-780754—, pp 212-221) **Methods for the recovery of nutrients and Energy from swine manure.** Boersma, L.; Gasper, E.; Warkentin, B.P. (Oregon State Univ., Corvallis). 1978.

From Solar Northwest conference; Portland, OR, USA (14 Jul 1978).

Energy and material balances were developed based on the feed enery needs and waste discharge of 100 pigs. Processes are explored which produce methane and fertilizer or methane and yeast or microfungi. Yields, modifications, and problems are discussed. (MHR)

13296 (COO—5035-3) **Herbaceous species screening program. Phase I. Final report.** Saterson, K.A.; Luppold, M.K.; Scow, K.M.; Lee, R.E. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jul 1979. Contract ET-78-C-02-5035. 140p. Dep. NTIS, PC A07/MF A01.

This report summarizes the results of Phase I of the DOE Biomass Energy Systems Branch Herbaceous Species Screening Program. The overall objective of the program is to designate the herbaceous plant species that might be promising candidates for biomass production in different regions of the United States (Phase I) and to then conduct field screenings on those species in order to identify the most promising species for future research and development (Phase II). The United States was divided into ten regions, based on the SCS Land Resource Areas, and the six that appear to offer the most potential for commercial biomass production were identified. A literature review and field interviews generated a list of 280 promising species, on which botanical as well as supplemental economic screenings were conducted for nine of the ten regions. The result of the screening is a list, for each region, of up to 20 species that appear to have potential for high biomass productivity and should be considered for inclusion in Phase II field screening. A total of 70 different species were included in the nine regional lists.

13297 (DOE/EV—0064) **Wood combustion systems: status of environmental concerns.** Dunwoody, J.E.; Takach, H.; Kelley, C.S.; Opalanko, R.; High, C.; Fege, A. (Mittelhauser Corp., Downers Grove, IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 132p. Dep. NTIS, PC A07/MF A01.

This document addresses the uncertainties about environmental aspects of Wood Combustion Systems that remain to be resolved through research and development. The resolution of these uncertainties may require adjustments in the technology program before it can be commercialized. The impacts and concerns presented in the document are treated generically without reference to specific predetermined sites unless these are known. Hence, site-specific implications are not generally included in the assessment. The report consists of two main sections which describe the energy resource base involved, characteristics of the technology, and introduce the environmental concerns of implementing the technology; and which review the concerns related to wood combustion systems which are of significance for the environment. It also examines the likelihood and consequence of findings which might impede wood commercialization such as problems and uncertainties stemming from current or anticipated environmental regulation, or costs of potential environmental controls. This document is not a formal NEPA document. Appropriate NEPA documentation will be prepared after a formal wood combustion commercialization program is approved by DOE.

13298 (EPRI-AF—1169) **Comparative assessment of marine biomass materials. Final report.** Show, I.T. Jr.; Piper, L.E.; Lupton, S.E.; Stegen, G.R. (Science Applications, Inc., Bellevue, WA (USA)). Sep 1979. 122p. Dep. NTIS, PC A06/MF A01.

The objectives of this study were to assess potential marine biomass sources and their preprocessing requirements. For the assessment of marine biomass sources, a priority list of marine plants was developed based on maximum potential organic yields, maximum potential calorific yields, and chemical composition. Yields were maximized and undesirable chemical properties minimized. The priority list was used to estimate maximum potential yields from US coastal water (from shore to the 200-mile limit of the Fisheries Conservation Zone). Preprocessing schemes were compared based on a comparative evaluation of energy consumption for each preprocessing step. The priority list of potential biomass sources produced 13 potential genera; five showed calorific yields far in excess of the other eight. These five (Laminaria, Chondrus, Fucus, Gracilaria, and Macrocystis) had calorific yields in excess of 50×10^3 kcal/m^2 - yr. No genus was found to be universally applicable to all US territorial waters. It was estimated that maximum potential national yield without mechanical nutrient upwelling could be as high as 30×10^{15} Btu/yr (30 quad). Results of the preprocessing study indicated that harvesting and size reduction operations may consume a large proportion of the energy available from the harvested biomass. It was found that biochemical conversion preprocessing incurs the least energy loss. It was also found that thermochemical conversion is probably not appropriate for marine biomass due to preprocessing energy losses.

13299 (LBL—8460) **Marine biomass system: anaerobic digestion and production of methane.** Haven, K.F.; Henriquez, M.; Ritschard, R.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1979. Contract W-7405-ENG-48. 84p. Dep. NTIS, PC A05/MF A01.

Two approaches to kelp conversion to methane are described. First, a large (10.56 mi^2) oceanic farm using an artificial substrate and an upwelling system to deliver nutrient-rich deep ocean water to the kelp bed is described. This system can yield as much as 50 tons of kelp (dry ash free - DAF) per acre-year. Kelp are harvested by a specially designed 30,000 DWT ship and delivered to an onshore processing plant as a ground kelp slurry. The second system involves the use of a natrual coastal kelp bed. Growth rates in this bed are stimulated by a nutrient rich sewer outfall. A conceptual model is presented for calculation of the growth rate of kelp in this natural bed which can reach 15 tons (DAF) per acre-year. The harvest activity and processing plant are similar to those for oceanic farm system. In the next section of this report, the overall concept of kelp production and conversion to methane is discussed. In Section III the general design of the ocean farm system is presented and discussed while Section IV contains a similar description for the natural bed system. Section V presents the capital requirements and operational labor, resources and material requirements. Section VI describes the environmental residuals created by the operation of either system and, to the extent possible, quantifies the rate at which these residuals are generated. In addition to the technical data reported herein, cost data have been generated for the various processes and components utilized in each solar technology. The requirements for costing information basically arise from the need to compute parameters such as investment demands, employment patterns, material demands and residual levels associated with each technology for each of several national and regional scenarios.

13300 (PB—296650) **Growing energy: land for biomass farms. Agricultural economic report (final).** Zeimetz, K.A. (Economics, Statistics, and Cooperatives Service, Washington, DC (USA). Natural Resource Eonomics Div.). Jun 1979. 41p. NTIS, PC A03/MF A01.

Biomass crops grown for energy conversion require high-quality land to maximize energy gain and minimize environmental hazards. The shortage of such land may hinder development of energy farms. Most of the 760 million acres of classes I-IV rural land of sufficient quality to support biomass production would need considerable conservation measures to overcome inherent development problems. Furthermore, alternative sources of food and fiber production would need to be found if the land were diverted to energy farms.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 13240, 13290, 13320, 13321, 13538, 13654

13301 (ALO—71, pp 140-149) **Turntable photovoltaic concentrator experiment at Sea World Park, Orlando, Florida.** Kirpich, A. Oct 1979.

In Summary of photovoltaic application experiments designs.

The General Electric/Sea World Photovoltaic Concentrator Applications Experiment will be located at Sea World's Marine Park near Orlando, Florida. The experiment will consist of nine azimuth-tracking turntable arrays, each containing twenty-four elevation-tracking parabolic trough PV concentrators of a type developed on this contract. The system will produce a peak power output of 330 kW and an annual net electrical energy of 355 MWh corresponding to an annual direct normal insolation of 1375.5 kWh/m^2. A line-commutated dc/ac inverter controlled to operate at the solar array maximum power point will deliver three-phase power through a bidirectional transformer to a 13-kilovolt line serving the Sea World park. In addition to generating electrical power, the system will produce 3.56×10^5 ton-hours of cooling for air conditioning a nearby shark exhibit by supplying collected thermal energy to a lithium-bromide absorption chiller. With credit included for the amount of electricity that would be required to produce this cooling by a vapor compression cycle, the overall system efficiency is estimated to be 11.7%.

13302 (COO—4094-71) **Simulation of the performance of a 100-kW-peak photovoltaic system.** Grossman, B.L.; Brench, B.L.; Bucciarelli, L.L.; Solman, F.J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1980. Contract EY-76-C-02-4094. 7p. (CONF-800106—17). Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

MIT Lincoln Laboratory designed and is currently constructing a 100-kW-peak photovoltaic (PV) power system for the Natural Bridges National Monument (NBNM). NBNM is located in a remote part of southeastern Utah and the PV system will operate in a stand-alone mode (i.e., no tie-in with a utility grid). Backup power will be supplied by an existing diesel-powered generator. The PV system and its individual components are being analyzed through the use of a computer simulation. Useful relationships have been found for system operating characteristics, array output, generator power usage, generator control strategy, storage losses and battery charge/discharge cycles. The system operating voltage can be set to extract maximum power from the array during the winter when that power is needed most. The generator operating strategy can be designed to minimize adverse effects on the batteries. Losses due to storage are offset by surplus array energy and by generator power.

13303 (COO—4094-73) **Performance of a photovoltaically powered air-conditioning system.** Kern, E.C. Jr.; Millner, A.R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1980. Contract EY-76-C-02-4094. 6p. (CONF-800106—14). Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A vapor-compression air conditioner coupled directly to a photovoltaic array is discussed. Previous analyses of such a system are reviewed, and a development system designed to test the concept is described. Preliminary experiments indicate that the performance of this initial system falls considerably short of analytic expectations.

13304 (DOE/ER—0038) **Preliminary materials assessment for the Satellite Power System (SPS).** Teeter, R.R.; Jamieson, W.M. (Battelle Columbus Labs., OH (USA)). Jan 1980. Contract W-7405-ENG-92. 131p. Dep. NTIS, PC A07/MF A01.

Presently, there are two SPS reference design concepts (one using silicon solar cells; the other using gallium arsenide solar cells). A materials assessment of both systems was performed based on the materials lists set forth in the DOE/NASA SPS Reference System Report: Concept Development and Evaluation Program. This listing identified 22 materials (plus miscellaneous and organics) used in the SPS. Tracing the production processes for these 22 materials, a total demand for over 20 different bulk materials (copper, silicon, sulfuric acid, etc.) and nealy 30 raw materials (copper ore, sand, sulfur ore, etc.) was revealed. Assessment of these SPS material requirements produced a number of potential material supply problems. The more serious problems are those associated with the solar cell materials (gallium, gallium arsenide, sapphire, and solar grade silicon), and the graphite fiber required for the satellite structure and space construction facilities. In general, the gallium arsenide SPS option exhibits more serious problems than the silicon option, possibly because gallium arsenide technology is not as well developed as that for silicon. Results are presented and discussed in detail. (WHK)

13305 (DOE/JPL/1012—38) **Low-Cost Solar Array Project. LSA field test annual report, August 1978-August 1979.** Jaffe, P. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Dec 1979. Contract EX-76-A-29-1012. 50p. Dep. NTIS, PC A03/MF A01.

In the course of three years of testing no evidence has resulted to suggest that the twenty-year-life goal for photovoltaic modules will not be met. Results of studies of more than 600 modules under test show that they are generally enduring well both electrically and physically, particularly those from more recent procurements. Degradation tests performed at JPL indicate that electrical degradation is not a slow monotonically increasing phenomenon as originally thought but occurs abruptly as the result of some traumatic event. This finding has led to a change in the test philosophy. The report includes a discussion of this change, a summary of degradation and failure data from all the sites, results from a variety of special tests, and a description of new instrumentation for in-field measurements. The field testing activity was expanded by the addition of twelve remote sites located as far away as Alaska and the Canal Zone. A description of the new sites is also included.

13306 (DOE/JPL/955149—1) **Residential photovoltaic module and array requirements study. Final report.** (Burt, Hill, Kosar, Rittlemann, and Associates, Butler, PA (USA)). Jun 1979. Contract NAS-7-100-955149. 63p. Dep. NTIS, PC A04/MF A01.

Burt Hill Kosar Rittelmann Associates has conducted a study to identify design requirements for photovoltaic modules and arrays used in residential applications. Building codes and referenced standards were reviewed for their applicability to residential photovoltaic array installations. Four installation types were identified - integral (replaces roofing), direct (mounted on top of roofing), stand-off (mounted away from roofing), and rack (for flat or low slope roofs, or ground mounted). Installation costs were developed for these mounting types as a function of panel/module size. cost drivers were identified. Studies were performed to identify optimum module shapes and sizes and operating voltage cost drivers. The general conclusion is that there are no perceived major obstacles to the use of photovoltaic modules in residential arrays. However, there is no applicable building code category for residential photovolttaic modules and arrays and early additional work is needed with standards writing organizations to develop residential module and array requirements.

13307 (DOE/TIC—11070) **Satellite power system (SPS) program. Program summary.** (Department of Energy, Washington, DC (USA). Div. of Solar Technology). Jan 1978. 34p. Dep. NTIS, PC A03/MF A01.

The objective of this joint DOE/NASA SPS concept evaluation program is to develop by the end of 1980 an initial understanding of the technical feasibility, economic practicability, and the social and environmental acceptability of the SPS concept so that recommendations concerning program continuation can be made. In executing its management responsibility. DOE, with the cooperation of NASA, has developed an SPS Concept Development and Evaluation Program Plan. This plan details the various technical and environmental subprograms or tasks needed to be completed by 1980. The four major study areas that have been identified are being undertaken during the SPS program are: (1) systems definition; (2) evaluation of environmental, health, and safety (EH and S) factors; (3) study of socioeconomic issues; and (4) comparative assessment of alternative energy systems. Descriptions of the SPS projects sponsored by DOE are presented. (WHK)

13308 (N—79-22617) **Space-based solar power conversion and delivery systems study. volume 1: executive summary. Final report, 30 sep. 1976 - 31 mar. 1977.** (ECON, Inc., Princeton, NJ (USA)). 31 Mar 1977. Contract NAS8-31308. 49p. NTIS PC A03/MF A01.

The research concerning space-based solar power conversion and delivery systems is summarized. The potential concepts for a photovoltaic satellite solar power system was studied with emphasis on ground output power levels of 5,000 MW and 10,000 MW. A power relay satellite, and certain aspects of the economics of these systems were also studied. A second study phase examined in greater depth the technical and economic aspects of satellite solar power systems. Throughout this study, the focus was on the economics of satellite solar power. The results indicate technical feasibility of the concept, and provide a preliminary economic justification for the first phase of a substantial development program. A development program containing test satellites is recommended. Also, development of alternative solar cell materials (other than silicon) is recommended.

13309 (N—79-22618) **Space-based solar power conversion and delivery systems study. volume 2: engineering analysis. Final report.** (Grumman Aerospace Corp., Bethpage, NY (USA)). 31 Mar 1977. Contract NAS8-31308. 264p. NTIS PC A12/MF A01.

The technical and economic feasibility of Satellite Solar Power Systems was studied with emphasis on the analysis and definition of an integrated strawman configuration concept, from which credible cost data could be estimated. Specifically, system concepts for each of the major subprogram areas were formulated, analyzed, and iterated to the degree necessary for establishing an overall, workable baseline system design. Cost data were estimated for the baseline and used to conduct economic analyses. The baseline concept selected was a 5-GW crystal silicon truss-type photovoltaic configuration, which represented the most mature concept available. The overall results and major findings, and the results of technical analyses performed during the final phase of the study efforts are reported.

13310 (N—79-22620) **Space-based solar power conversion and delivery systems study. volume 4: energy conversion systems studies. Final report.** (Little (Arthur D.), Inc., Cambridge, MA (USA)). 29 Mar 1977. Contract NAS8-31308. 74p. NTIS PC A04/MF A01.

Solar cells and optical configurations for the SSPS were examined. In this task, three specific solar cell materials were examined: single crystal silicon, single crystal gallium arsenide, and polycrystalline cadmium sulfide. The comparison of the three different cells on the basis of a subsystem parametric cost per kW of SSPS-generated power at the terrestrial utility interface showed that gallium arsenide was the most promising solar cell material at high concentration ratios. The most promising solar cell material with no concentration, was dependent upon the particular combination of parameters representing cost, mass and performance that were chosen to represent each cell in this deterministic comparative analysis. The potential for mass production, based on the projections of the present state-of-the-art would tend to favor cadmium sulfide in lieu of single crystal silicon or gallium arsenide solar cells.

13311 (N—79-22621) **Space-based solar power conversion and delivery systems study. volume 5: economic analysis. Final report.** (ECON, Inc., Princeton, NJ (USA)). 31 Mar 1977. Contract NAS8-31308. 279p. NTIS PC A13/MF A01.

Space-based solar power conversion and delivery systems are studied along with a variety of economic and programmatic issues relevant to their development and deployment. The costs, uncertainties and risks associated with the current photovoltaic Satellite Solar Power System (SSPS) configuration, and issues affecting the development of an economically viable SSPS development program are addressed. In particular, the desirability of low earth orbit (LEO) and geosynchronous (GEO) test satellites is examined and critical technology areas are identified. The development of SSPS unit production (nth item), and operation and maintenance cost models suitable for incorporation into a risk assessment (Monte Carlo) model (RAM) are reported. The RAM was then used to evaluate the current SSPS configuration expected costs and cost-risk associated with this configuration. By examining differential costs and cost-risk as a function of postulated technology developments, the critical technologies, that is, those which drive costs and/or cost-risk, are identified. It is shown that the key technology area deals with productivity in space, that is, the ability to fabricate and assemble large structures in space, not, as might be expected, with some hardware component technology.

13312 (N—79-22632) **Satellite power systems (SPS) concept definition study exhibit c. volume 3: experimental verification definition. Final report.** (Rockwell International Corp., Downey, CA (USA). Space Div.). Mar 1979. Contract NAS8-32475. 152p. NTIS PC A08/MF A01.

An environmentally oriented microwave technology exploratory research program aimed at reducing the uncertainty associated with microwave power system critical technical issues is described. Topics discussed include: (1) Solar Power Satellite System (SPS) development plan elements; (2) critical technology issues related to the SPS preliminary reference configuration; (3) pilot plant to demonstrate commercial viability of the SPS system; and (4) research areas required to demonstrate feasibility of the SPS system. Progress in the development of advanced GaAs solar cells is reported along with a power distribution subsystem.

13313 (N—79-22633) **Satellite power systems (SPS) concept definition study, exhibit c. volume 5: special emphasis studies. Final report.** Hanley, G. (Rockwell International Corp., Downey, CA (USA). Space Div.). Mar 1979. Contract NAS8-32475. 265p. NTIS PC A12/MF A01.

Specific areas were analyzed and identified as high priority for more in-depth analysis. These areas were: (1) rectenna constructability; (2) satellite constructability; (3) support systems constructability; (4) space environmental analysis, and (5) special end-to-end analyses. Baseline requirements specified coplanar solar blankets and an end mounted antenna, utilizing either GaAlAs solar cells and employing a CR of 2, or Si cells. Several configurations were analyzed. Utilizing the preferred configuration as a baseline, a satellite construction base was defined, precursor operations incident to establishment of orbital support facilities identified, and the satellite construction sequence and procedures developed. Since the baseline specifies sixty instead of one hundred and twenty satellites to be constructed in a thirty year period, mass flow to orbit requirements were revised and new traffic models established. Launch site requirements (exclusive of actual launch operations) in terms of manpower and building space were defined.

13314 (N—79-22634) **Satellite power systems (SPS) concept definition study, exhibit c. volume 6: in-depth element investigation. Final report.** Hanley, G. (Rockwell International Corp., Downey, CA (USA). Space Div.). Mar 1979. Contract NAS8-32475. 97p. NTIS PC A05/MF A01.

Computer assisted design of a gallium arsenide solid state dc-to-RF converter with supportive fabrication data was investigated. Specific tasks performed include: computer program checkout; amplifier comparisons; computer design analysis of GaAs solar cells; and GaAs diode evaluation. Results obtained in the design and evaluation of transistors for the microwave space power system are presented.

13315 (SAND—80-0110C) **Photovoltaic system sizing analysis.** Jones, G.J.; Mehalick, E.M. (Sandia Labs., Albuquerque, NM (USA); General Electric Co., Philadelphia, PA (USA)). 1980. Contract EY-76-C-04-0789. 10p. (CONF-800106—20). Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

A primary concern in designing any photovoltaic system is the determination of its optimum size. In grid-connected applications this is normally considered to be one which delivers energy to the owner's load at the minimum lifecycle cost, including the cost of backup utility energy. A great deal can be learned about system design by making use of simple analytical relationships to study the effect of various design parameters on sizing. The purpose of this paper is to show one such model and apply it to study the effect of load and the fixed and variable costs on photovoltaic system sizing.

13316 (SAND—80-0111C) **Energy storage in grid-connected applications.** Jones, G.J. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 8p. (CONF-800106—11). Dep. NTIS, PC A02/MF A01.

From 14. photovoltaics specialists conference; San Diego, CA, USA (7 Jan 1980).

While energy storage is usually an option when designing any photovoltaic system, in grid-connected applications the decision for or against on-site storage is based on operational considerations. If

the photovoltaic system has the option of returning energy to the utility grid for credit, then the question of storage is determined by the capital cost of storage and its efficiency versus the cost of sellback in terms of lost energy. The present paper analyzes this situation, as well as time-of-day pricing, in detal to determine the allowable lifecycle cost of storage in each of the possible operating modes.

13317 Closed loop solar array-ion thruster system with power control circuitry. Gruber, R.P. US Patent 4,143,314. 6 Mar 1979. Filed date 29 Mar 1978. 8p.

A power control circuit connected between a solar array and an ion thruster receives voltage and current signals from the solar array. The control circuit multiplies the voltage and current signals together to produce a power signal which is differentiated with respect to time. The differentiator output is detected by a zero crossing detector and, after suitable shaping, the detector output is phase compared with a clock in a phase demodulator. An integrator receives no output from the phase demodulator when the operating point is at the maximum power but is driven toward the maximum power point for non-optimum operation. A ramp generator provides minor variations in the beam current reference signal produced by the integrator in order to obtain the first derivative of power.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 13240, 13307, 13386, 13538

13318 (DOE/ET/20516—2) **Solar thermal small power systems study, program summary report. Phase II: study results.** Lapedes, D.E.; Munjal, P.K.; Sitney, L.R. (Aerospace Corp., Los Angeles, CA (USA). Energy and Resources Div.). 12 Jul 1979. Contract ET-78-C-03-2226. 239p. Dep. NTIS, PC A11/MF A01.

This Phase II Study of small solar power systems (SSPS) has been structured to determine conditions under which SSPS can be cost-effective sources of electric power in the US in the period 1985 to 2015. An extensive data base, which provides a discrete identification of all utility and industrial electric generating units up to and including 10 MW/sub e/ in rated capacity, has been prepared. This data base defines the market for which comparative evaluations are made of SSPS and alternative fossil-fueled power plants. The market penetration of SSPS is determined and the effect of economic incentives on accelerating the penetration is evaluated. The solar electric power system is evaluated as either a complete replacement for existing conventional electric power systems or as a repowering installation for boilers supplying steam to turbine-driven generators. The cost data used in the market penetration analysis are for a central receiver-type of small solar theral power system. While the market penetration discussed herein is for this type of SSPS, the sensitivity data in the report can be used to determine the market penetration of other types of solar thermal power systems (e.g., point focus distributed receiver) with different system costs.

13319 (DOE/NASA/1060—79/3) **Potential performance improvement using a reacting gas (nitrogen tetroxide) as the working fluid in a closed Brayton cycle.** Stochl, R.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1979. Contract EX-76-A-29-1060. 24p. (NASA-TM—79322). Dep. NTIS, PC A02/MF A01.

The results of an analysis to estimate the performance that could be obtained by using a chemically reacting gas (nitrogen tetroxide) as the working fluid in a closed Brayton cycle are presented. Compared with data for helium as the working fluid, these results indicate efficiency improvements from 4 to 90 percent, depending on turbine inlet temperature, pressures, and gas residence time in heat-transfer equipment. This concept could be attractive for solar thermal power applications.

13320 (N—79-22615) **Introductory assessment of orbiting reflections for terrestrial power generation.** Billman, K.W.; Gilbreath, W.P.; Bowen, S.W. (National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). Apr 1977. 58p. NTIS PC A04/MF A01.

The use of orbiting mirrors for providing energy to ground conversion stations to produce electrical power is shown to be a viable, cost effective and environmentally sound alternative to satellite solar power stations and conventional power sources. This is accomplished with the use of very light weight metal coated polymeric films as mirrors which, after deployment at 800 km, are placed in operational orbit and controlled by solar radiation pressure. Relations are developed showing the influence of a number of parameters (mirror altitude, orbit inclination, period, mirror size and number, and atmospheric effects) on the reflected insolation that may be received by a ground spot as a function of location. Some attractive alternative uses of the reflection are briefly discussed as a beneficial adjuncts to the system.

13321 (N—79-22616) **Systems definition space based power conversion systems: executive summary. Final report.** (Boeing Aerospace Co., Seattle, WA (USA)). 1977. Contract NAS8-31628. 29p. NTIS PC A03/MF A01.

Potential space-located systems for the generation of electrical power for use on earth were investigated. These systems were of three basic types: (1) systems producing electrical power from solar energy; (2) systems producing electrical power from nuclear reactors; (3) systems for augmenting ground-based solar power plants by orbital sunlight reflectors. Configurations implementing these concepts were developed through an optimization process intended to yield the lowest cost for each. A complete program was developed for each concept, identifying required production rates, quantities of launches, required facilities, etc. Each program was costed in order to provide the electric power cost appropriate to each concept.

13322 (N—79-26534) **Analysis of helio-thermoelectrical energy conversion efficiency analyse energetique de la conversion heliothermo-electrique.** Tran, T.S. (Electricite de France, 78 - Chatou). Feb 1977. 136p. NTIS, PC A07/MF A01.

The whole process of indirect conversion of solar energy to electricity is surveyed. A model of sun radiation is discussed considering sun trajectory, local time, and atmospheric as well as meteorological conditions. Optical concentration systems such as linear and point concentration, parabolic mirrors, sun-tracking, mirror supports and protections, automation of heliostat fields, etc., are described. Photothermic energy conversion systems are analyzed discussing the dimensioning of radiation boilers, heat-transporting fluids, and losses in solar boilers. Finally, the thermodynamic conversion end is discussed taking into consideration thermodynamic cycle alternatives, specific conversion problems, and fundamental options available. Practical examples refering to the THEM I project in France are presented.

13323 (SAN—1890-1) **Investigation of a solar thermal powered pump for agricultural application. Final report.** Calkins, D.E.; Keenan, T.L.; Bate, E.R. (Systems Exploration, Inc., San Diego, CA (USA)). Sep 1978. Contract ET-78-C-03-1890. 90p. Dep. NTIS, PC A05/MF A01.

A simple solar thermal powered water raising device, for irrigation applications, has been investigated. The concept is based on the use of a closed piston system comprising a condensable working fluid and an array of solar collector panels in conjunction with a mechanical system comprising a cable, lever, pulley and water bucket. The alternate heating and cooling of the solar panels in turn evaporates (expands) and condenses (contracts) the working fluid thereby moving the piston in a vertical direction. This vertical movement is transmitted through the cable, lever and pulley assembly to a vertical movement of a second cable which raises a bucket of water, dumps it on the solar panel thus cooling it and allowing the bucket to lower back to the water, where the cycle begins again. A computer model of the operational cycle of the water raising device has been developed. The model addresses the transient heat transfer, thermodynamic, fluid mechanics and economic aspects of the problem. The model was used to simulate the yearly operation of a nominal 2 ft. diameter x 5 ft. stroke piston operating with a 10 ft. head. The location of operation was assumed to be at a latitude of 32°, which corresponds roughly to San Diego, California. Freon 21, Freon 12 and butane were investigated as the working fluid, with Freon 12 providing the maximum yearly pumping capacity. The economic model was used to compare the yearly cost of the solar pump with that of conventional pumps using available electricity, and conventional pumps with gasoline and diesel powered generators. It was determined that the solar pump would be competitive with the conventional pump for electrical power costs of about $0.10/kW-h, while if operating in areas where generators must be used, the solar pump will have significantly lower yearly costs.

CENTRAL RECEIVER

13324 (DOE/ET/20426—1) **Line focus solar thermal central receiver research study. Final report, April 30, 1977-March 30, 1979.** Di Canio, D.G.; Treytl, W.J.; Jur, F.A.; Watson, C.D. (FMC Corp., Santa Clara, CA (USA). Engineered Systems Div.). Apr 1979. Contract EY-76-C-03-1246. 314p. Dep. NTIS, PC A14/MF A01.

The results of a study to examine the line focus central receiver alternative for solar thermal generation of electric power on a commercial scale are presented. The baseline concept consists of the following elements: (1) a solar collector (heliostat) whose geometry is the equivalent of a focused parabolic cylinder. The heliostat reflecting surface is composed of an array of flexible rectangular mirror panels supported along their long edges by a framework which rotates about an axis parallel to the ground plane. The mirror panels in one section (18.3 meters by 3.05 meters (60 feet by 10 feet)) are defocused in unison by a simple mechanism under computer control to achieve the required curvature. Two sections (110 meters^2(591 feet^2)) are controlled and driven in elevation by one control/drive unit. (2) A linear cavity receiver, composed of 61-

meter (200-foot) sections supported by towers at an elevation of 61 meters (200 feet). Each section receives feedwater and produces turbine-rated steam. The cavity is an open cylinder 1.83 meters (6 feet) in inside diameter, with a 1.22 meter (4 foot) aperture oriented at 45 degrees to the collector field. (3) Heliostat control, consisting of a local controller at each heliostat module which communicates with a master control computer to perform elevation tracking and focal length adjustment. The control logic is open-loop, with sun position computer by the master computer with an algorithm. Image sensors, mounted above and below the receiver aperture, are used to monitor the collector field and provide feedback to the master computer for detection of misaligned heliostats. (WHK)

13325 (N—79-26535) **Elements for technological and economic modeling of tower-type solar power plants elements de modelisation technico-economique d'une centrale electrosolaire a tour.** Manteau, G. (Electricite de France, 78 - Chatou). Jan 1977. 110p. NTIS, PC A06/MF A01.

Fixed parameters relative to the investment cost of a solar powered turbogenerator are studied. A numerical analysis is done for a type THEM 1 solar power station; the effects of certain investment cost parameters on feasibility are studied for this case. Suggestions for improvement on the design and for alternative applications of the model are offered. An optimal size for solar facilities to obtain an optimal output value vis a vis costs and foreseen demand is also discussed.

13326 (SAN—1109-79-2) **Wind tunnel test of 1/30 scale heliostat field array model. Test report.** Brown, G.L. (Honeywell, Inc., St. Petersburg, FL (USA). Avionics Div.). 22 Feb 1978. Contract EY-76-C-03-1109. 168p. Dep. NTIS, PC A08/MF A01.

From 9 January through 20 January 1978, Honeywell conducted a wind tunnel test on a 1/30 scale partial heliostat field. The heliostats were per Honeywell's design developed under the 10 megawatt central receiver pilot electrical power plant subsystem research experiment contract. Likewise, the scaled section of the field geometry duplicated the proposed circular layout. Testing was conducted at the Georgia Institute of Technology's 9 foot subsonic tunnel. The objective of the test was to ascertain from a qualitative standpoint the field effects upon wind loading within a heliostat field. To accomplish this, numerous pressure tap measurements at different heights and at different field positions were taken with varying wind speeds, fence designs, and heliostat gimbal orientations. The Department of Energy specified boundary layer profile was also scaled by 1/30 in order to simulate the total wind effects as accurately as possible taking into account the potentially severe scaling or Reynolds number effects at a 1/30 scale. After initial model set-up within the tunnel and scaled boundary layer generated, 91 separate runs were accomplished. The results do demonstrate the high sensitivity of wind loading upon the collector field due to the actual heliostat orientation and fence geometry. Vertical pressure gradients within the model field and flow reentry angles provide a good qualitative feel as to the full scale environment that might be expected and point to the need for specific additional testing to further explore potentially dangerous conditions.

13327 (SAN—1468-1) **Solar central receiver prototype heliostat: phase 1. Final technical report, September 30, 1977-June 24, 1978.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Oct 1978. Contract EG-77-C-03-1468. 385p. Dep. NTIS, PC A17/MF A01.

The complete preliminary design analysis and drawings of the heliostat system that were used as the basis for the manufacturing conceptual design and cost estimates are presented. Complete costing data is included along with all of the assumptions and data used in studying the production processes. A detailed description of the control system design is given together with a full report on the breadboard testing of the linear motor drives and the self-calibrating control system. Specifications and a conceptual design of the Automatic Foundation Machine are provided as well as a complete description of the installation process and its labor and time estimates. The enclosed heliostat consists of an aluminized film reflector which is deployed on a lightweight, eight-strut frame mounted on a single pipe pedestal with azimuth and elevation drives and totally housed in an air supported enclosure. An open loop control system with self calibration capability directs centrally computed sun angles and steering commands to individual heliostats of a total system via 2-way multiplex methods over the field power distribution network. Totally mass-produced in conventional industrial factories, the preassembled components are shipped without restriction and are semi-automatically installed within 30-minute time cycles. Requiring no cleaning, the 30-year life cycle maintenance costs include two complete enclosure and reflector replacements. (WHK)

13328 (SAN—1468-1(App.)) **Solar central receiver prototype heliostat: phase 1. Appendices to final technical report, September 30, 1977-June 24, 1978.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Oct 1978. Contract EG-77-C-03-1468. 164p. Dep. NTIS, PC A08/MF A01.

The appendices include (A) design compliance with DOE 001 specification, (B) General Electric heliostat parts list and drawings, (C) specular solar transmittance and reflectance measurements, (D) preliminary draft-design specification for conceptual design of automatic foundation machine, (E) Ingersoll-Rand critique of GE automatic foundation machine concept, and (F) appendix to section 4.0 - controls and drives. (WHK)

13329 (SAN—1483-1/1) **Conceptual design of advanced central receiver power systems sodium-cooled receiver concept. Volume 1. Executive summary. Final report.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Jun 1979. Contract EG-77-C-03-1483. 64p. (ESG—79-2(Vol.1)). Dep. NTIS, PC A04/MF A01.

The conceptual design of an advanced central receiver power system using liquid sodium as a heat transport medium has been completed by a team consisting of the Energy Systems Group (prime contractor), McDonnell Douglas, Stearns-Roger, The University of Houston, and Salt River Project. The purpose of this study was to determine the technical and economic advantages of this concept for commercial-scale power plants. This final report covers all tasks of the project. These tasks were as follows: (1) review and analysis of preliminary specification; (2) parametric analysis; (3) select commercial configuration; (4) commercial plant conceptual design; (5) assessment of commercial plant; (6) advanced central receiver power system development plan; (7) program plan; (8) reports and data; (9) program management; and (10) safety analysis. A programmatic overview of the accomplishments of this program is given. The 100-MW conceptual commercial plant, the 281-MW optimum plant, and the 10-MW pilot plant are described. (WHK)

13330 (SAN—1483-1/2) **Conceptual design of advanced central receiver power systems sodium-cooled receiver concept. Volume 2, Book 1. Commercial plant conceptual design. Final report.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Mar 1979. Contract EG-77-C-03-1483. 400p. (ESG—79-2(Vol.2)(Bk.1)). Dep. NTIS, PC A17/MF A01.

The conceptual design of the 100-MW solar tower focus commercial power plant is described in detail. Sodium is pumped up to the top of a tall tower where the receiver is located. The sodium is heated in the receiver and then flows down the tower, through a pressure reducing device, and thence into a large, hot storage tank which is located at ground level and whose size is made to meet a specific thermal energy storage capacity requirement. From this tank, the sodium is pumped by a separate pump, through a system of sodium-to-water steam generators. The steam generator system consists of a separate superheater and reheater operating in parallel and an evaporator unit operating in series with the other two units. The sodium flowing from the evaporator unit is piped to a cold storage tank. From the cold storage tank, sodium is then pumped up to the tip of the tower to complete the cycle. The steam generated in the steam generators is fed to a conventional off-the-shelf, high-efficiency turbine. The steam loop operates in a conventional rankine cycle with the steam generators serving the same purpose as a conventional boiler and water being fed to the evaporator with conventional feedwater pumps. The pressure reducing device (a standard drag valve, for example) serves to mitigate the pressure caused by the static head of sodium and thus allows the large tanks to operate at ambient pressure conditions. (WHK)

13331 (SAN—1483-1/3) **Conceptual design of advanced central receiver power systems sodium-cooled receiver concept. Volume 2, Book 2. Appendices. Final report.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Mar 1979. Contract EG-77-C-03-1483. 533p. (ESG—79-2(Vol.2)(Bk.2)). Dep. NTIS, PC A23/MF A01.

The appendices include: (A) design data sheets and P and I drawing for 100-MWe commercial plant design, for all-sodium storage concept; (B) design data sheets and P and I drawing for 100-MWe commercial plant design, for air-rock bed storage concept; (C) electric power generating water-steam system P and I drawing and equipment list, 100-MWe commercial plant design; (D) design data sheets and P and I drawing for 281-MWe commercial plant design; (E) steam generator system conceptual design; (F) heat losses from solar receiver surface; (G) heat transfer and pressure drop for rock bed thermal storage; (H) a comparison of alternative ways of recovering the hydraulic head from the advanced solar receiver tower; (I) central receiver tower study; (J) a comparison of mechanical and electromagnetic sodium pumps; (K) pipe routing study of sodium downcomer; and (L) sodium-cooled advanced central receiver system simulation model. (WHK)

13332 (SAN—1483-1/5) **Conceptual design of advanced central receiver power systems sodium-cooled receiver concept. Volume 4. Commercial and pilot plant cost data. Final report.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Mar 1979. Contract EG-77-C-03-1483. 200p. (ESG—79-2(Vol.4)). Dep. NTIS, PC A09/MF A01.

This volume of the advanced central receiver final report presents the cost data using the cost breakdown structure identified in the preliminary specification. Cost summaries are presented in the following sections for the 100-MWe and 281-MWe commercial plant and a 10-MWe pilot plant. Cost substantiation data for this volume are presented in the appendices. Other cost summary data include Nth plant data for the 100-MWe and 281-MWe commercial plants, and a summary for the alternative concept air-rock storage system. The main description of the plant costing technique occurs as part of Section II for the 100-MWe baseline concept.

13333 (SERI/TR—8043-(Vol.1)) **Heliostat manufacturing cost analysis. Volume 1.** Drumheller, K.; Schulte, S.C.; Dilbeck, R.A.; Long, L.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Oct 1979. Contract EG-77-C-01-4042;EY-76-C-06-1830. 83p. Dep. NTIS, PC A05/MF A01.

This study has two primary objectives. The first is to provide a detailed cost evaluation of the second generation of DOE heliostats, from which repowering heliostat designs are likely to be derived. A second objective is to provide an analytical foundation for the evaluation of futue heliostat designs. The approach taken for this study was to produce a cost estimate for the production of the McDonnell Douglas prototype design by generating estimates of the materials, labor, overhead, and facilities costs for two different production scenarios, 25,000 heliostats per year and 250,000 heliostats per year. The primary conclusion of this study is that the second generation of heliostat designs should cost approximately $100/m^2 at volumes of 25,000 units/year. This price falls to approximately $80/m^2 at volumes of 250,000 units/year. A second conclusion is that cost reduction begins at relatively low production volumes and that many production benefits can be obtained at production rates of 5,000 to 15,000 units/year. A third conclusion is that the SAMICS model and the SAMIS III program can be useful tools in heliostat manufacturing, costing, and economic studies.

13334 **Effect of optical surface properties on high-temperature solar thermal energy conversion.** Wen, L. (JPL, Pasadena). *J. Energy;* 3: No. 2, 82-89(Mar-Apr 1979).

The effects of thermal surface properties on the performance of representative point-focusing solar power plants are assessed. The tradeoff relationships are presented in terms of normalized system performance as a function of thermal optical design parameters. Crucial surface properties include solar reflectance, specular spreading due to microscopic roughness, surface error due to manufacturing slope tolerance or waviness, and concentrator pointing accuracy. Two representative power conversion systems, a Rankine steam cycle and an open-air Brayton cycle, are considered. 15 refs.

13335 **Experiments with heliostats for central receiver power plants.** Thornton, J.P.; Waddington, D. (Martin Marietta Corp, Denver, Colo). *J. Energy;* 3: No. 2, 69-74(Mar-Apr 1979).

Two new applications of standard techniques are providing more accurate measurements of heliostat performance over longer ranges. Four experimental heliostats have been fabricated and installed in the Solar Test Facility at Martin Marietta, Denver. Performance testing of these heliostats has been completed, and the resulting data are being used to support the design of commercial central receiver solar power plants. Both the design of the experimental heliostats and the results of the performance testing are described.

DISTRIBUTED COLLECTOR

13336 (SAN—2073-1) **Conceptual design and analysis of a 100 MWe distributed line focus solar central power plant. Topical report, September 29, 1978-May 4, 1979.** Semmens, M.G.; Fong, A.; Collaros, G.J.; Dascher, R.E.; Grassberger, R.E.; Griego, D.B.; Stueber, T.F. (BDM Corp., Albuquerque, NM (USA)). 1979. Contract ET-78-C-03-2073. 327p. Dep. NTIS, PC A15/MF A01.

A program to develop the optimum line focus solar central power plant system conceptual design is reported in detail. The approach consisted of a parametric analysis of each of the seven major subsystems: collector, receiver tube, working fluid, heat transport subsystem, energy storage subsystem, electric power generating subsystem, and master control subsystem. Systems analysis and selection of the baseline 100 MWe line focus power plant are described. Detailed performance and cost summaries are included. (WHK)

TOTAL ENERGY AND HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 13301

13337 (ALO—3985-1(Rev.1)) **Solar total energy project Shenandoah.** (General Electric Co., Philadelphia, PA (USA). Advanced Energy Dept.). 10 Jan 1980. Contract EG-77-C-04-3985. 340p. Dep. NTIS, PC A15/MF A01.

This document presents the description of the final design for the Solar Total Energy System (STES) to be installed at the Shenandoah, Georgia, site for utilization by the Bleyle knitwear plant. The system is a fully cascaded total energy system design featuring high temperature paraboloidal dish solar collectors with a 235 concentration ratio, a steam Rankine cycle power conversion system capable of supplying 100 to 400 kW(e) output with an intermediate process steam take-off point, and a back pressure condenser for heating and cooling. The design also includes an integrated control system employing the supervisory control concept to allow maximum experimental flexibility. The system design criteria and requirements are presented including the performance criteria and operating requirements, environmental conditions of operation; interface requirements with the Bleyle plant and the Georgia Power Company lines; maintenance, reliability, and testing requirements; health and safety requirements; and other applicable ordinances and codes. The major subsystems of the STES are described including the Solar Collection Subsystem (SCS), the Power Conversion Subsystem (PCS), the Thermal Utilization Subsystem (TUS), the Control and Instrumentation Subsystem (CAIS), and the Electrical Subsystem (ES). Each of these sections include design criteria and operational requirements specific to the subsystem, including interface requirements with the other subsystems, maintenance and reliability requirements, and testing and acceptance criteria. (WHK)

OCEAN THERMAL GRADIENT POWER PLANTS

13338 (COO—2681-3) **Theoretical evalutation of the seakeeping behavior of large OTEC plant platforms and cold water pipe configurations.** Barr, R.A.; Murphy, P.; Ankudinov, V. (Hydronautics, Inc., Laurel, MD (USA)). Aug 1978. Contract EY-76-C-02-2681. 102p. Dep. NTIS, PC A06/MF A01.

A theoretical study of the seakeeping behavior of a number of large ocean thermal energy conversion (OTEC) platform/cold water pipe configurations is described. Both the theoretical methods employed and parametric calculated results are described. In the present study five generic platform types (ship, submarine, semi-submersible, disc and spar) and three CWP materials (aluminum, reinforced concrete and glass reinforced plastic or GRP) were considered.

13339 (COO—4931-02) **Feasibility design study. Land-based OTEC plants. Final report.** Brewer, J.H.; Minor, J.; Jacobs, R. (Deep Oil Technology, Inc., Long Beach, CA (USA)). Jan 1979. Contract ET-78-C-02-4931. 199p. Dep. NTIS, PC A09/MF A01.

The purpose of this study has been to determine the feasibility of installing 10 MWe (MegaWatt-electric) and 40 MWe land-based OTEC demonstration power plants at two specific sites: Keahole Point on the western shore of the island of Hawaii; and Punta Tuna, on the southeast coast of the main island of Puerto Rico. In addition, the study has included development of design parameters, schedules and budgets for the design, construction and operation of these plants. Seawater systems (intake and discharge pipes) were to be sized so that flow losses were equivalent to those expected with a platform-based OTEC power plant. The power module (components and general arrangement was established based on the TRW design. Results are presented in detail. (WHK)

13340 (DOE/ET—0118) **Ocean energy systems. Fiscal year 1979, program summary.** (Department of Energy, Washington, DC (USA). Office of Solar, Geothermal, Electric and Storage Systems). 1979. 284p. Dep. NTIS, PC A13/MF A01.

A review of ocean thermal energy conversion technology, test facilities, and research programs is given; and project summaries for DOE contracts are included. The project summaries list the contractor, contract title and number, funding, and work location and provide a brief description of the project. Also, project summaries for technologies for alternate ocean energy systems employing ocean currents, ocean waves, and salinity gradients are included. The technical status and program plans for each of the alternate technologies are discussed. (WHK)

13341 (HIG—79-6) **OTEC-1 anchor site survey. Final report.** Campbell, J.F.; Erlandson, D. (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). Jun 1979. Contract EY-76-C-03-1093. 60p. Dep. NTIS, PC A04/MF A01.

Three areas were investigated to determine their suitability as anchor sites for the Ocean Thermal Energy Conversion (OTEC) test platform. Required were a flat, 800 to 1500-meter deep bottom with an area 5 km in diameter that was in reasonable proximity of a land based logistics supply station. Of the three areas, Maui terrace, South Point, Hawaii, and Kohala terrace, the latter was best suited for the test site. An additional criterion 30 m of sediment cover had to be abandoned when it became evident that the Kohala terrace area had nowhere more than 5 to 7 meters of sediment. A mass anchor has been suggested rather than a self-setting or implanting anchor to secure the OTEC-1 platform because of the thin sediment cover in the area. Bathymetric data, based on 3.5-kHz reflection records, were contoured and two areas were delineated on the Kohala

terrace which met the criteria set previously. Bottom photographs, bottom samples, sediment thickness profiles, a biologic mid-water trawl, current data, temperature profiles and meteorological observations supplied further information concerning the two sites. The southern site at approximately 156°10.5'W, 19°55.5'N was selected as the most suitable anchor site.

13342 (SAN—1570-2/1) **Ocean thermal energy conversion (OTEC). Power system development. Preliminary design report, final.** (TRW Systems and Energy, Redondo Beach, CA (USA)). 4 Dec 1978. Contract EG-77-C-03-1570. 489p. Dep. NTIS, PC A21/MF A01.

The preliminary design of the 10 MWe OTEC power module and the 200 kWe test articles is given in detail. System operation and performance; power system cost estimates; 10 MWe heat exchangers; 200 kWe heat exchanger articles; biofouling control;ammonia leak detection, and leak repair; rotating machinery; support subsystem; instrumentation and control; electrical subsystem; installation approach; net energy and resource analysis; and operability, maintainability, and safety are discussed. The conceptual design of the 40 MWe electrical power system includes four or five 10 MWe modules as designed for the 10 MWe pilot plant. (WHK)

13343 **Ocean thermal energy conversion.** Griffin, O.M. (ed.). New York, NY; American Society of Mechanical Engineers (1978). 106p. (CONF-781112—).

From ASME energy technology conference; Houston, TX, USA (5 Nov 1978).

This conference proceedings contains six papers, all of which are indexed separately. Topics range from a brief glimpse at several early and recent novel ideas for OTEC utilization to an overview of the United States OTEC development program. Specific problems associated with the overall technology of OTEC (Ocean Thermal Energy Conversion) plants are also presented. Problems associated with the design of systems to bring high-voltage power cables from the ocean floor to an OTEC plant are examined.

SOLAR RADIATION UTILIZATION

REFER ALSO TO CITATION(S) 13237, 14028

13344 (CONF-781261—) **National solar energy convention of Solar Energy Society of India. Solar energy for rural development.** (Central Salt and Marine Research Inst., Bhavnagar (India)). 1978. 748p. Dep. NTIS (US Sales Only), PC A99/MF A01.

From National solar energy convention; Bhavnagar, India (20 Dec 1978).

Separate abstracts have been prepared for the approximately 100 included papers. (MOW)

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 13235, 13241, 13381, 13824

13345 (AD-A—062719) **Design of solar heating and cooling systems. Final report.** Joncich, D.M.; Leverenz, D.J.; Hittle, D.C.; Walton, G.N. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Oct 1978. 57p. Availability: Microfiche copies only.

This report presents a method for making an energy and an economic cost/benefit analysis of solar energy systems. A graphical method is presented for evaluating the performance of solar domestic hot water systems, solar heating systems, and solar heating and cooling systems. Methods for selecting the optimum collector area based on benefit-to-cost ratio and for systemtically making detailed design calculations using the Building Loads Analysis and System Thermodynamics (BLAST) computer simulation program are also presented. Practical considerations for solar system designs are discussed. The methods presented provide the required accuracy for both initial evaluations and final design calculations. Examples are provided throughout the text to aid in using the methods described.

13346 (BNL—27137) **Experimental results from the first year of operation of the solar ground coupling research facility at Brookhaven National Laboratory.** Meta, P.D. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 14p. (CONF-791204—19). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Results from the first year of operation of the solar ground coupling research facility at Brookhaven National Laboratory (BNL) are presented. Nine experiments which are first generation ground coupled heat transfer and storage devices for a solar source heat pump system have been operated since December 1978. A computer program called GROCS which models the heat transfer between these devices and the earth has been written (and subsequently integrated with the solar energy system simulation program TRNSYS by John W. Andrews). In this paper the ground coupling research program, the first generation experiments, and the underground heat flow model GROCS are described. Experimental results from December 1978 to September 1979 are presented and compared to model directions.

13347 (BNL—51061) **Trnsys-compatible model of ground-coupled storage.** Andrews, J.W. (Brookhaven National Lab., Upton, NY (USA)). Sep 1979. Contract EY-76-C-02-0016. 25p. Dep. NTIS, PC A02/MF A01.

The use of the ground as a source of heat and as a storage element for low-grade heat in solar assisted heat pump systems is the subject of an ongoing program of research at Brookhaven National Laboratory. As part of this program, a computer model of ground-coupled storage was developed. This report describes the integration of this program into the transient simulation computer program TRNSYS to allow the hour-by-hour simulation of solar heating and cooling systems which use ground coupling. The report is intended to serve as a user's manual for the TRNSYS-compatible ground-coupling subroutines.

13348 (COO—2588-T1) **Simulation and design of solar thermal processes.** (Wisconsin Univ., Madison (USA). Solar Energy Lab.). 31 Oct 1979. Contract EY-76-S-02-2588. 16p. Dep. NTIS, PC A02/MF A01.

Research on simulation using TRNSYS and FCHART methods is described including systems analysis, user services, design procedures, and model validation. (MHR)

13349 (COO—2868-5) **Performance evaluation of a solar air-heating and nocturnal cooling system in CSU Solar House II. Final report, June 1, 1977-September 30, 1978.** Karaki, S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Apr 1979. Contract EY-76-S-02-2868. 173p. Dep. NTIS, PC A08/MF A01.

The solar heating system in Solar House II consists of 67.1 m^2 of double-glazed air-heating collectors with flat-black absorbers, 10.3 m^3 of pebble bed storage, air-to-water heat exchanger for preheating domestic water and one blower to circulate the air through the system. The nocturnal cooling system consists of an evaporative cooler and utilizes the pebble bed for cool storage. A schematic diagram of the system is shown.

13350 (COO—4643-02) **Continuing regional solar energy information mini-center activities and updating the SOLOCOST program. Quarterly report.** Lantz, L.J. (Solar Environmental Engineering Co., Inc., Fort Collins, CO (USA)). Apr 1979. Contract EG-77-C-02-4643. 23p. Dep. NTIS, PC A02/MF A01.

The progress made during this period is reported for each of the following tasks: (1) interactive SOLCOST interface; (2) energy conservation - solar system optimization; (3) detailed duct sizing; (4) extension of SOLCOST data base; (5) portable FORTRAN version; (6) automatic collector parameter subroutine; (7) the solar index; and (8) operation of the SOLCOST mini-center. (MOW)

13351 (COO—30122-3) **CSU Solar House III. Solar heating and cooling system performance. Progress report, 1 October 1978-31 May 1979.** Ward, D.S.; Oberoi, H.S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Aug 1979. Contract AC02-79-CS-30122. 47p. Dep. NTIS, PC A03/MF A01.

During the period 1 October 1978 through 31 March 1979, the Chamberlain liquid-heating state-of-the-art flat-plate solar collector was evaluated for a complete heating season. The data acquisition and analysis was a continuation of the cooling season performance evaluation conducted during the summer and fall of 1978. Significant and important results of the systems evaluation include: (1) The demonstration of the critical importance of temperature differentials between the collector outlet and the absorption chiller generator inlet, the effects of alternative control strategies, the marginal feasibility of cool storage, the devastating effect on system performance due to heat losses from the thermal storage unit, and the importance of minimizing electrical parasitic power requirements in obtaining feasibility for solar absorption cooling systems. (2) The concept of overall system efficiency was shown to be essential in the determination of the feasibility of any solar installation. (3) Evaluation of acquired data on the performance of the CSU Solar House III system has provided the theoretical construction and experimental verification of the importance of solar operating threshold (i.e., the minimum solar radiation intensity at which the collector can collect useful solar heat).

13352 (DOE/CS/4048—2) **West Chester Work Center: solar space heating demonstration project.** (Bell Telephone Co. of Pennsylvania, Philadelphia (USA)). May 1979. Contract EY-76-C-02-4048. 47p. (COO—4048-2). Dep. NTIS, PC A03/MF A01.

This document reports on the construction stage of a solar space heating demonstration project. It describes an integrated system providing solar energy space heating for a 9982 sq. ft., newly

built, one-story building. The building is located at 966 Matlack Street, West Goshen Township, Chester County, Pennsylvania. Functionally, the building consists of two sections: An Office and a Storeroom. The Office section is heated by solar-assisted water-to-air heat pump units. The Storeroom section is heated by an air-handling unit, containing a water-to-air coil. Solar energy is expected to provide 62% of the heating load, with the balance provided by a back-up electric boiler. The system includes 1900 active (2112 gross) square feet of flat-plate solar collectors, and a 6000 gallon above-ground indoor storage tank. Freeze protection is provided by a gravity drain-down scheme combined with nitrogen pressurization in a closed circuit.

13353 (DOE/NASA/CR—161340) **Prototype solar heating and combined heating and cooling systems. Quarterly report No. 9.** (General Electric Co., Philadelphia, PA (USA). Space Div.). 2 Oct 1978. Contract EX-76-A-29-1037. 45p. Dep. NTIS, PC A03/MF A01.

Eight prototype solar heating and combined heating and cooling systems are under development. This effort includes development, manufacture, test, installation, maintenance, problem resolution, and performance evaluation.

13354 (LA-UR—80-246) **Control system analysis for off-peak auxiliary heating of passive solar systems.** Murray, H.S.; Melsa, J.L.; Balcomb, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800101—7). Dep. NTIS, PC A02/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A computer simulation method is presented for the design of an electrical auxiliary energy system for passive solar heated structures. The system consists of electrical mats buried in the ground underneath the structure. Energy is stored in the ground during utility off-peak hours and released passively to the heated enclosure. An optimal control strategy is used to determine the system design parameters of depth of mat placement and minimum instaled electrical heating capacity. The optimal control applies combinations of fixed duration energy pulses to the heater, which minimize the room temperature error-squared for each day, assuming advance knowledge of the day's weather. Various realizable control schemes are investigated in an attempt to find a system that approaches the performance of the optimal control system.

13355 (LA-UR—80-248) **Thermal and cost goal analysis for passive solar heating designs.** Noll, S.A.; Kirschner, C. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800101—8). Dep. NTIS, PC A02/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

Economic methodologies developed over the past several years for the design of residential solar systems have been based on life cycle cost (LCC) minimization. Because of uncertainties involving future economic conditions and the varied decision making processes of home designers, builders, and owners, LCC design approaches are not always appropriate. To deal with some of the constraints that enter the design process, and to narrow the number of variables to those that do not depend on future economic conditions, a simplified thermal and cost goal approach for passive designs is presented. Arithmetic and graphical approaches are presented with examples given for each. Goals discussed include simple payback, solar savings fraction, collection area, maximum allowable construction budget, variable cost goals, and Btu savings.

13356 (LASL—78-30) **Solar heating and cooling research at Los Alamos Scientific Laboratory.** (Los Alamos Scientific Lab., NM (USA)). Sep 1978. Contract W-7405-ENG-36. 26p. Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM 87545.

The six program areas funded by DOE are described by describing six projects which best exemplify the research efforts: (1) Technical Support to DOE, (2) Solar Collector and Materials Research, (3) Passive Solar Systems Studies, (4) Mobile/Modular Homes, (5) The National Security and Resources Study Center, and (6) The Nambe Community Center. (MHR)

13357 (LBL—9294) **Passive solar design process for a small office/laboratory building.** Andersson, B.; Kammerud, R.; Place, W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 15p. (CONF-791009—26). Dep. NTIS, PC A02/MF A01.

From International conference on energy use management; Los Angeles, CA, USA (22 Oct 1979).

In order to assess the compatibility of existing passive solar design tools with the architectural process, a case study design for a small commercial building has been performed. The architectural process employed in the design is presented, the areas within the process for which appropriate tools are not immediately available are identified, and some improved tools are proposed. The potential advantages of passive solar design for a small commercial building in an adverse climate are demonstrated.

13358 (LBL—9371) **Design calculations for passive solar buildings by a programmable hand calculator.** Goldstein, D.B.; Lokmanhekim, M.; Clear, R.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 81p. (CONF-7908103—1). Dep. NTIS, PC A05/MF A01.

From Izmir International symposium-II on solar energy fundamentals and applications; Izmir, Turkey (6 Aug 1979).

The behavior of room temperature in a passive solar building without backup heat is of great interest to the building designer. Programs are presented for card-reading programmable hand-calculators which compute room temperature over the course of a design day. Instructions for calculating the input parameters, and for running the programs are given, and a brief review of the theory is provided. The program can presently be used only for single-zone unmanaged, direct-gain buildings.

13359 (SAN—1510-1) **Solar heating system for the First Baptist Church, 1500 E. Melgaard Road, Aberdeen, South Dakota 57401. Final report.** Salem, H.E. (Michaud, Cooley, Hallburg, Erickson, and Associates, Inc., Minneapolis, MN (USA)). 16 Apr 1979. Contract EG-77-A-03-1510. 66p. Dep. NTIS, PC A04/MF A01.

This report includes the following: (1) acceptance test plan, (2) systems performance data, (3) pictures of completed system, (4) problems in building the system, (5) description of the system, (6) major maintenance problems, (7) revised blueprints, (8) installation, operation, and maintenance manuals, and (9) recommendations.(MOW)

13360 (SERI/TP—351-501) **SERI DOE-2 solar simulator study.** Eden, A.; Simms, D.A. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 7p. (CONF-800101—6). Dep. NTIS, PC A02/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

The Solar Energy Research Institute's (SERI) analysis of the solar energy simulator section of DOE-2, a public domain computer program that allows users to explore the energy-use patterns of proposed and existing buildings and their heating, ventilating, and air conditioning (HVAC) systems is discussed. This computer program contains a solar energy simulation portion called Component-Based Simulator (CBS) incorporated into the HVAC Plant (large equipment) section. SERI is investigating the adequacy and sensitivity of DOE-2's solar portion when various active solar energy systems and combinations of solar components are interfaced with standard space conditioning systems or used in a stand-alone mode. The components have been assembled into typical configurations and parametric test runs have been performed examining the problems associated with the program and the characteristics of the output for eventual comparison with other energy analysis computer programs.

13361 (SERI/TP—351-548) **Standard assumptions and methods for solar heating and cooling systems analysis.** Leboeuf, C.M. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 7p. (CONF-800101—9). Dep. NTIS, PC A02/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A set of inputs, assumptions, analytical methods, and a reporting format is presented to help compare the results of residential and commercial solar system analyses being performed by different investigators. By the common use of load data, meteorological data, economic parameters, and reporting format, researchers examining, for example, two types of collectors may more easily compare their results. For residential heating and cooling systems, three locations were selected. The weather data chosen to characterize these cities are the Typical Meteorological Year (TMY). A house for each location was defined that is typical of new construction in that locale. Hourly loads for each location were calculated using a computerized load model that interacts with the system specified inputs characterizing each house. Four locations for commercial cooling analyses were selected from among the existing sites for which TMYs were available. A light commercial (nominal 25-ton cooling load) office building was defined and is used in all four locations. Hourly cooling and heating loads were computed for each city and are available on magnetic tape from the Solar Energy Research Insititute (SERI).

13362 (SERI/TP—355-490) **Sensitivity analysis of a community solar system using annual cycle thermal energy storage.** Baylin, F.; Monte, R.; Sillman, S. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1979. Contract EG-77-C-01-4042. 14p. (CONF-791204—18). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

The objective of this research is to assess the sensitivity of design parameters for a community solar heating system having annual thermal energy storage to factors including climate, building type, community size, and collector type and inclination. The system under consideration uses a large, water-filled, concrete-constructed

tank for providing space heating, and domestic hot water (DHW). Collector field area and storage volume have been sized for 440 community designs in 10 geographic locations. Analysis of the data has allowed identification of those parameters that have first order effects on component sizing. Two linear relationships were derived which allow system sizing. The average ambient temperature is used to determine average yearly collector efficiency. This parameter combined with estimates of space/DHW loads, storage/distribution losses, and total yearly insolation per square meter allows estimation of collector area. Storage size can be estimated from the winter net load which is based on space and DHW loads, storage/distribution losses, and collector solar heat for the winter months. (MHR)

13363 (SOLAR/1005—79/50) **Solar project description for Florida gas company's single family residence, Winter Springs, Florida.** (Boeing Aerospace Co., Seattle, WA (USA)). 22 Jun 1979. Contract EX-76-A-29-1020. 56p. Dep. NTIS, PC A04/MF A01.

The Florida Gas Company solar energy system is installed in a 1548 square-foot, three bedroom single family dwelling located in Winter Springs, Florida. The system is designed to provide solar energy for space heating, space cooling, and domestic hot water heating. Solar energy is collected by two banks of double glazed flat plate collectors with a gross area of 714 square feet. Solar energy is transferred from the collector array to a 1350 gallon underground storage tank. Water is used as the heat collection, transfer and storage medium. Freeze protection is provided by means of circulation of hot water from storage through the collectors. No anti-freeze additive is required. A 3-ton solar energy powered absorption cycle Water Chiller provides chilled water for circulation through the same air distribution system. A gas fired boiler provides supplemental thermal energy to the chiller when sufficient thermal energy is not available from storage. Original cost estimates for provisioning and installation of the Solar System are given.

13364 (SOLAR/1015—79/50) **Solar project description for Perl-Mack Enterprises' single family residences, Denver, Colorado.** (Boeing Aerospace Co., Seattle, WA (USA)). 21 Aug 1979. Contract EG-77-C-01-4049. 50p. Dep. NTIS, PC A03/MF A01.

The Perl-Mack Enterprises Co. solar energy system(s) are installed in a total of 25 single family dwellings located in Denver, Colorado. The 25 dwellings are of three different configurations. Two of the twenty-five dwellings have been fully instrumented for performance monitoring and evaluation since September 1977. All the solar systems are designed to provide approximately 69 percent of the space heating and energy requirements for each dwelling. Solar energy is collected by an array of flat plate collectors having a gross area of 470 square feet. A water-glycol mixture is used as the medium for delivering solar heat from the collection to the storage tank. The storage tank has a total capacity of 945 gallons. A liquid-to-liquid heat exchanger, within the storage tank, transfers the stored heat from the transfer medium to the domestic hot water tank of the house. Space heating demands are met by circulating heated water/glycol mixture from the storage tank through the heat exchanger coil installed downstream from the auxiliary furnace blower. The auxiliary gas-fired furnace is activated whenever room thermostat demands heat.

13365 (SOLAR/1038—79/50) **Solar project description for Saddle Hill Trust single family residences, Medway, Massachusetts.** (Boeing Co., Huntsville, AL (USA)). 24 Aug 1979. Contract EG-77-C-01-4049. 51p. Dep. NTIS, PC A04/MF A01.

The Saddle Hill Trust solar energy systems are installed in three single family dwellings (Lots 36, 73, and 77) located in Medway, Massachusetts. Each of the dwellings are four bedroom, two story frame structures. Lot 36 has 1944 square feet, lots 73 and 77 have 1696 square feet. All these dwellings are fully instrumented for performance monitoring and evaluation. The three systems are designed to preheat domestic water. Lot 36, in addition to preheat domestic water includes solar energy for house heating. The data in this report is for lot 36, since this system is more complex and provides building heating. In this system, water is the heat transfer fluid. Solar energy is collected by two banks of flat plate collectors with a gross area of 315 square feet. Solar energy storage is provided by circulating water through the solar collectors and a heat exchanger in a 750 gallon basement equipment room storage tank. Space heating demands are met by circulating water from storage through a heating coil in the air distribution system in the house heating system. Auxiliary space heating is provided by an oil-fired warm air furnace. Solar energy for pre-heating domestic hot water is provided by circulating water from the solar storage tank through a heat exchanger in an electric domestic hot water heater. The performance of the Saddle Hill Trust Solar Energy System has been monitored since December 1978. Original cost estimates for provisioning and installation of the solar system are given; however the final cost of its instrumentation are not included.

13366 (SOLAR/1057—79/14) **Solar energy system performance evaluation. Zien Mechanical Contractors No. 1: single-family residence, Milwaukee, Wisconsin, October 1978-March 1979.** Werner, C.L. (International Business Machines Corp., Gaithersburg, MD (USA)). 1978. Contract EG-77-C-01-4049. 67p. Dep. NTIS, PC A04/MF A01.

Zien Mechanical Contractors No. 1 is a single-family residence in Milwaukee, Wisconsin. The home has approximateiy 1304 square feet of conditioned space. The solar energy system consists of two independently controlled systems: one system serves domestic hot water (DHW) preheating; the other is used for space heating and space cooling. Only the space heating and cooling system is described. The system has an array of flat-plate collectors with a gross area of 384 square feet. The array faces south at an angle of 53 degrees to the horizontal. Air is the transfer medium that delivers solar energy from the collector array to storage. Solar energy is stored in a rock bin containing 41,250 pounds of rock located in the basement of the house. The rock bin has 2 inches of polyurethane insulation on the outside walls and fiberglass roll insulation in the ceiling. A heat pump delivers solar energy from storage to a heat exchanger located within an air-handler. Heated air is then blown from the air-handler to the load. When solar energy is insufficient to satisfy the space heating load, an electric resistance heater in the air-handler provides auxiliary energy for space heating. The system has 10 modes of solar operation for space conditioning. The performance of the system for the period October 1978 through March 1979 is described. (WHK)

13367 (SOLAR/1090—79/50) **Solar project description. Albuquerque Western-II multi-dwelling building, Albuquerque, New Mexico.** Moore, D. (Boeing Co., Seattle, WA (USA)). 23 Nov 1979. Contract EX-76-A-29-1020. 43p. Dep. NTIS, PC A03/MF A01.

The Albuquerque Western - II site is a four-story, 110-unit apartment building in Albuquerque, New Mexico. The solar energy system consists of a controlled system to preheat hot water used in space heating. The solar energy system is designed to provide approximately 54 percent of the conditioned space heating load. The system has an array of tracking collectors with a gross area of 6429 square feet. The array faces south at an angle of 35 degrees to the horizontal. Water is used as the medium for delivering energy from the collector array to storage. Solar energy is stored underground in a 57,000-gallon concrete storage tank. During the space heating season, the heated water from storage is continuously circulated through the building to satisfy the space heating needs for each apartment. Auxiliary heating is provided by three inline gas-fired boilers. The system has three modes of operation. Original cost estimates for provisioning and installation of the solar system are given. (MOW)

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 13059, 13379

13368 (LA-UR—80-184) **High temperature thermochemical hydrogen cycles for solar heat sources.** Bowman, M.G. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 16p. (CONF-791143—3). Dep. NTIS, PC A02/MF A01.

From Users Association solar fuels workshop; Albuquerque, NM, USA (28 Nov 1979).

Some of the criteria required for high temperature thermochemical hydrogen cycles to couple efficiently with solar heat sources are defined. Some of the experimentally validated cycles that have been developed over the years in terms of these criteria are examined and potential cycles that are being considered for the higher temperatures potentially available from solar concentrators are discussed. Cycles discussed include oxide-sulfate cycles, halide hydrolysis cycles, direct decomposition of H_2O and CO_2, oxide cycles, and sulfuric acid-metal sulfate cycles. (WHK)

13369 (SERI/TP—332-495) **Problems and opportunities fr solar energy in biomass, pyrolysis, and gasification.** Reed, T. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1979. Contract EG-77-C-01-4042. 12p. Dep. NTIS, PC A02/MF A01.

Passive solar input for drying crops and wood already make a significant input to the US energy budget, and active solar drying, requiring temperatures below 200°C, can easily make an important substitution for fossil fuels in drying. Pyrolysis of biomass typically requires less than 1.6 MBtu/dry ton at a temperature of 500°C, and this could potentially be supplied by direct solar heating. The heat input is likely to be by indirect heating of a solid, liquid or gas heat-transfer agent. Fast pyrolysis requires modest heat inputs with high heat-transfer rates at temperatures over 900°C and thus may be particularly suited to focusing collectors as energy sources. Char gasification, using steam or CO_2, requires large energy inputs at temperatures over 900°C and thus is the least likely field of application of solar energy. Ultimately, the large scale application of solar energy to biomass pyrolysis and gasification will depend on the relative cost of direct solar versus biomass inputs. Biomass energy inputs now typically cost 1 to 3 $/MBtu; when direct solar heat costs begin to approach this level, we may begin to use direct solar process heat for biomass conversion.

13370 (SERI/TR—351-481) **Applications and systems studies for solar industrial process heat.** Brown, K.C. (Solar Energy Research Inst., Golden, CO (USA)). Jan 1980. Contract EG-77-C-01-4042. 17p. Dep. NTIS, PC A02/MF A01.

The program has been highlighted by the development of analytical computer programs, engineering case studies in specific industries, applications and market studies and the assessment of operating experience in actual solar installations. For example, two analytical computer codes (known as PROSYS and ECONMAT) have been assembled and used for the large-scale matching of industrial processes with different types of solar equipment. Verification of the results of this large-scale matching have resulted in a program of detailed case studies of solar and conservation options in local dairies, metal can manufacturing plants, meatpacking plants, and other factories.

WATER HEATING

REFER ALSO TO CITATION(S) 13241, 13345, 13363, 13364, 13365, 13381

13371 (COO—4664-1) **Cost effective solar hot water system for Econo-Travel Motor Hotel located at Richmond, Virginia. Final report.** (Solar Systems of Virginia, Inc., Hampton (USA)). Sep 1979. Contract EM-78-G-02-4664. 17p. Dep. NTIS, PC A02/MF A01.

The final report is presented of a cost effective solar hot water heating system installed on the Econo-Travel Motor Hotel at 5408 Williamsburg Road, Richmond, Virginia. The description of the system is given along with the final cost breakdown, expected performance data and expected payback time for the installed system is estimated to be approximately five (5) years instead of the 6.65 years estimated for the proposal. The additional savings is due to the reduction in the peak demand charge since the electric hot water heaters are not required to operate at the same time each morning as the dryers used for the laundry. The success of the system will be determined by the reduction in the utility cost and reduced use of our fossil fuels. The results shown in the hotel's monthly electricity bills indicate that this goal has been accomplished.

13372 (COO—4665-1) **Cost effective solar hot water system for Econo-Travel Motor Hotel located at Bluefield, West Virginia. Final report.** (Solar Systems of Virginia, Inc., Hampton (USA)). Jul 1979. Contract EM-78-G-02-4665. 16p. Dep. NTIS, PC A02/MF A01.

The final report of a cost effective solar hot water heating system installed on the Econo-Travel Motor Hotel at 3400 Cumberland Road, Bluefield, West Virginia. The description of the system along with the final breakdown performance data and payback time are given. The payback time for the installed system will be approximately five (5) years instead of the 7.73 years estimated for the proposal. The additional savings is due to the reduction in the peak demand charge since the electric hot water heaters are not required to operate at the same time each morning as the dryers used for the laundry. The success of the system will be determined by the reduction in the utility cost and reduced use of our fossil fuels. The results shown in the hotel's monthly electricity bills indicate that this goal has been accomplished.

13373 (COO—4719-2) **Microprocessor controlled solar collector system. Technical progress report No. 3.** (Middlebury Coll., VT (USA)). 15 Nov 1979. Contract EM-78-S-02-4719. 14p. Dep. NTIS, PC A02/MF A01.

The strategy and initial results of a microprocessor control system for a solar water heating system are described. Two hot water storage tanks are utilized. (WHK)

13374 (SOLAR/1010—79/50) **Solar project description for A-Frame Industries' single family residence: Kaneohe, Hawaii.** (Boeing Co., Seattle, WA (USA)). 27 Jul 1979. Contract EX-76-A-29-1020. 44p. Dep. NTIS, PC A03/MF A01.

The A-Frame Industries site is located in Kaneohe, Hawaii, and is a single family residence containing a solar energy system designed to provide domestic hot water heating. It is an open system, utilizing city water pressure to overcome the pressure head of the DHW tank and solar collector subsystem. The system uses city water as the common heat transfer medium, and contains no energy storage tank or DHW tank heat exchanger loop. Therefore, the total operating energy is in the energy collection and storage subsystem (ECSS). The collector consists of an array of four flat-plate collectors with a gross area of 76.6 square feet. The collectors face 10 degrees east of south at an angle of 21 degrees from the horizontal. The heat transfer medium is potable water, which is stored in a 120 gallon water heater storage tank and supplied, on demand, to the domestic hot water supply. Auxiliary heat is supplied by a 4 kilowatt electrical heating element. The collector loop pump is activated when the collector temperature exceeds the storage temperature by 5°F. The pump is stopped when this temperature difference becomes less than 2°F. The hot water service design temperature is 140°F. No maximum temperature control or freeze protection is provided. The house has been fully instrumented for performance evaluation of the solar system since February 1978 and the compiled data are integrated into the National Solar Data Network. Original cost estimates for provisioning and installation of the solar system are given; the final solar system and instrumentation cost are not included. (WHK)

13375 (SOLAR/1011—79/14) **Solar Energy System Performance Evaluation. Albuquerque Western No. 1, Albuquerque, New Mexico, October 1978-March 1979.** Fu, C.M. (International Business Machines Corp., Gaithersburg, MD (USA)). 1979. Contract EG-77-C-01-4049. 65p. Dep. NTIS, PC A04/MF A01.

The Albuquerque Western site is a four-story, 110-unit apartment building in Albuquerque, New Mexico. The solar energy system consists of two independently controlled systems: one system serves domestic hot water (DHW) preheating needs, the other serves to preheat hot water used in space heating. Only the DHW system is described in this report. The solar energy system has an array of tracking collectors with a gross area of 1782 square feet. The array faces south at an angle of 35 degrees to the horizontal. Water is the transfer medium that delivers solar energy from the collector array to storage. Solar energy is stored in a 2000-gallon wooden tank that contains a plastic liner. The DHW is continuously circulated throughout the building. When solar energy is insufficient to satisfy the hot water energy requirements, auxiliary heating is provided by an inline gas-fired boiler. An operational summary of the performance of the system for the period October 1978 through March 1979 is presented. (WHK)

13376 (SOLAR/1011—79/50) **Solar project description for Albuquerque Western-1 multi-dwelling building, Albuquerque, New Mexico.** (Boeing Aerospace Co., Seattle, WA (USA)). Sep 1979. Contract EX-76-A-29-1020. 42p. Dep. NTIS, PC A03/MF A01.

The Albuquerque Western - I solar energy system is installed in a 110-unit apartment building located in Albuquerque, New Mexico. The system is designed to provide solar energy for domestic hot water heating. The DHW solar energy collection and storage system utilizes 1782 square feet (gross) of south-facing tracking collectors mounted at a tilt angle of 35° to horizontal. Original cost estimates for provisioning and installation of the solar system are given.

13377 (SOLAR/1014—79/50) **Solar project description for Hei Wai Wong multi-dwelling building, Honolulu, Hawaii.** (Boeing Aerospace Co., Seattle, WA (USA)). Oct 1979. Contract EX-76-A-29-1020. 43p. Dep. NTIS, PC A03/MF A01.

The Hei Wai Wong site is a 4-story, 55 unit apartment building in Honolulu, Hawaii. Three solar systems are installed at this project to supplement the domestic hot water (DHW) requirements, and include preheating the laundry hot water for average usage rate. The solar energy system collector-to-storage results from thermosyphoning. The flat plate collector array has a gross area of 3,002 sq ft of which 807.4 square feet is instrumented. The collectors are facing south with a collector tilt of 24°. Collected energy is accumulated in the 1230 gallon water tank that is roof top mounted. Such preheated water can be gravity fed to the laundry and apartment units. Auxiliary heating of the hot water in each apartment is provided by 30 gallon tanks using electric resistance heat elements. Auxiliary heating of the hot water in the laundry is provided by an 85 gallon tank fired by natural gas.

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 13327, 13328, 13333

13378 (ALO—35356-1) **Superior heat transfer fluids for solar heating and cooling applications. Semiannual report, 20 August 1978-20 February 1979.** Parts, L.; Miller, D.R.; Thompson, Q.E. (Monsanto Research Corp., Dayton, OH (USA)). Sep 1979. Contract EM-78-C-04-5356. 55p. (MRC-DA—904). Dep. NTIS, PC A04/MF A01.

The objectives of this program are: (1) to quantify the required design and handling properties of heat transfer fluids for solar collector applications, (2) to collect data and pertinent information for all fluids presently used or envisioned as potentially useful in solar energy applications, based on the current state of the art, and (3) to organize the latter information to allow the designers of solar collection systems to select optimum fluids for their particular needs. Two broad surveys have been conducted. One encompassed the designers and manufacturers of solar collectors and collection systems to establish the data base for the required fluids properties. The results of this survey are summarized in this report. The second survey was addressed to the manufacturers of heat transfer fluids. A list of commercially available heat transfer fluids, to which further additions are anticipated, is also included.

13379 (ANL—79-102) **Design of a system using CPC collectors to collect solar energy and to produce industrial process steam.** Hsieh,

C.K. (Argonne National Lab., IL (USA)). Aug 1979. Contract W-31-109-ENG-38. 105p. Dep. NTIS, PC A06/MF A01.

A system has been designed to use CPC collectors to collect solar energy and to generate steam for industrial process heat purposes. The system is divided into two loops with the collectors in the collector loop to operate a preheater and the collectors in the boiler loop to heat water to elevated pressures and temperatures. A flash boiler is used to throttle the heated water to steam. Two types of CPC collectors are chosen. In the collector loop the CPC collectors are fitted with concentric tube receivers. In the boiler loop the collectors employ heat pipes to transmit heat. This design is able to alleviate the scaling and plumbing problems. A fragile receiver tube can also be employed without rupture difficulties. The thermal processes in the collectors were analyzed using a computer modeling. The results were also used to develop a thermodynamic analysis of the total system. Calculations show that the design is technically feasible. The CPC collector is shown to have an efficiency that is very weakly dependent on its operating temperatures, which makes the collector particularly attractive in high temperature applications.

13380 Fluorescent planar concentrators: performance and experimental results. Goetzberger, A.; Heidler, K.; Wittwer, V.; Zastrow, A.; Bauer, G.; Sah, E. (Fraunhofer-Institut fuer Angewandte Festkoerperphysik, Freiburg, Germany). pp 515-523 of 2nd E.C. photovoltaic solar energy conference. Van Overstraeten, R.J.; Plaz, W. (eds.). Hingham, MA; D. Reidel Publishing Co. (1979).

From 1979 photovaltaic solar energy conference; West Berlin, F.R. Germany (23 Apr 1979).

Fluorescent concentrators operate on the principle of fluorescent light conversion and guidance by total internal reflection. An advantage of this type of concentrator is the possibility of collecting also diffuse radiation and the division of the incoming solar spectrum into different wavelength fractions. Each part can be converted by solar cells optimized for a narrow photon energy range. The first experimental results of collector efficiency and stability are presented.

13381 (COO—2705-3) Solair heater program: solair applications study. Final report. (General Electric Co., Philadelphia, PA (USA)). Dec 1977. Contract EY-76-C-02-2705. 96p. Dep. NTIS, PC A05/MF A01.

General Electric has designed and tested a low-cost solar system using a vacuum tube solar air heater under ERDA Contract E(11-1)-2705. This contract extension has been provided to evaluate various applications of this solar collector. The evaluation identified attractive applications, evaluated corresponding control procedures, estimated system performance, compared economically insolation and insulation, and evaluated the repackaging of off-the-shelf equipment for improved cost effectiveness. The results of this study prompted General Electric's marketing group to do a detailed commercialization study of a residential domestic water heating system using the Solair concept which has been selected as the most attractive application. Other attractive applications are space/domestic water heating and a heat pump assisted solar system/domestic water heating where the heat pump and the solar system function in parallel. A prime advantage of heated air solar systems over liquid systems is cost and longer life which results in higher BTU's/dollar. Other air system advantages are no liquid leakage problems, no toxicity of freezing problems, and less complicated equipment. A hybrid solar system has been identified that can improve the market penetration of solar energy. This system would use the existing mass of the house for energy storage thereby reducing solar cost and complexity. Adequate performance can be obtained with house temperature swings comparable to those used in nighttime setback of the thermostat. Details of this system are provided.

13382 (COO—4996-1) Development of materials for a luminescent solar collector. Annual progress report, September 1, 1978-August 31, 1979. Lempicki, A.; Andrews, L.; McCollum, B.C. (GTE Labs., Inc., Waltham, MA (USA)). 1979. Contract ER-78-C-02-4996. 42p. Dep. NTIS, PC A03/MF A01.

The objectives of the research involved preparation of a number of Cr^{3+} doped glasses beginning with common commercial types, and expansion of the number and variety of glasses as time allowed. The Cr^{3+} doped glasses have been evaluated by spectroscopic measurements which have included absorption and emission as well as quantum yield determinations. In addition, the influence of concentration quenching was measured by studying the luminescence decay kinetics at various concentrations in a variety of glasses. As the program developed, and the problem of rather low quantum yields became apparent in all the glasses, a rather detailed investigation was undertaken to better understand the radiationless decay of Cr^{3+} in order to best evaluate the future direction of the program. The results are summarized. (WHK)

13383 (DOE/NASA/CR—161339) Outdoor test for thermal performance evaluation of the Owens-Illinois Sunpak SEC-601 (air) solar collector. (Wyle Labs., Huntsville, AL (USA). Solar Energy Systems Div.). Dec 1979. Contract EX-76-A-29-1037. 29p. Dep. NTIS, PC A03/MF A01.

The test procedures used and the test results obtained during the performance of an evaluation test program on the Owens-Illinois Sunpak, model SEC-601, air solar collector under natural outdoor weather conditions are presented. All testing activities were performed on a single module installed on the Marshall Space Flight Center Solar House. The test was performed and the data evaluated according to the methods provided in ASHRAE 93-77 (Method of Testing to Determine the Thermal Performance of Solar Collectors) as applicable to outdoor testing of solar collectors.

13384 (EFI—79-42) Design and test of non-evacuated solar collectors with compound parabolic concentrators. Rabl, A.; O'Gallagher, J.; Winston, R. (Chicago Univ., IL (USA). Enrico Fermi Inst.). Jul 1979. Contract EY-76-S-02-2446. 60p. Dep. NTIS, PC A04/MF A01.

The intermediate range of concentration ratios (1.5X-10X) which can be achieved with CPC's without diurnal tracking provides both economic and thermal advantages for solar collector design even when used with non-evacuated absorbers. The present paper summarizes more than 3 years of research on non-evacuated CPC's and reviews measured performance data and critical design considerations. Concentrations in the upper portions of the practical range (e.g. 6X) can provide good efficiency (40% to 50%) in the 100°C to 160°C temperature range with relatively frequent tilt adjustments (12 to 20 times per year). At lower concentrations (e.g. 3X) performance will still be substantially better than that for a double glazed flat plate collector above about 70°C and competitive below, while requiring only semi-annual adjustments for year round operation. In both cases the cost savings associated with inexpensive reflectors, and the optimal coupling to smaller, simple inexpensive absorbers (e.g. tubes, fins, etc.) can be as important an advantage as the improved thermal performance.

13385 (SAND—79-1802) Heat transfer fluid experiences at the MSSTF. McCulloch, W.H. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 21p. Dep. NTIS, PC A02/MF A01.

Samples of the heat transfer fluid (mixture of Therminol 66 and Caloria HT43) have been taken periodically from the DOE/Sandia Midtemperature Solar Systems Test Facility for the purpose of determining whether there is any long-term degradation as evidenced by changes in fluid thermophysical properties. This report compares the results from three different investigators and concludes that there has been no significant change attributable to thermal degradation after almost four years since first operation.

HEAT STORAGE

REFER ALSO TO CITATION(S) 13362

13386 (N—79-22631) Research on energy storage for solar thermal conversion. Final report. Clayton, J.L. (Xerox Electro-Optical Systems, Pasadena, CA (USA)). Oct 1978. Contract NSF C-7522234. 128p. NTIS PC A07/MF A01.

Thermal energy storage (TES) for solar thermal energy conversion to electric power was studied. Major emphasis was placed on determining the relative merits of latent, sensible, and hybrid latent-sensible storage systems. The thermal energy storage systems evaluated are compatible with 10 MW and 100 MW steam power plants with TES delivery temperature ranges of 400 to 600 F and 900 to 110 F. Also evaluated is a 200 kW - 2000 kW combination total energy system. The initial phase of the study involved a review of storage material thermophysical properties and analysis of the phase change heat transfer mechanism. Analytical studies presented include TES parametric and steam cycle analyses. Design studies were performed and resulting TES system designs are presented. Major TES cost factors are evaluated and summarized. Finally, TES system reliability, safety, and environmental effects are presented. It is concluded that a hybrid latent-sensible energy storage system is most efficient from a thermodynamic viewpoint for use in conjunction with a steam power plant. Sensible energy storage is presently less costly to implement than latent storage utilizing current heat exchanger technology, however latent energy storage offers high energy density and the potential for future cost reduction.

13387 (ORO—5759-T1) Thermal energy storage subsystems for solar heating and cooling applications: rolling cylinder thermal storage. Interim report. Thornton, R.F.; Herrick, C.S. (General Electric Co., Schenectady, NY (USA)). Jun 1979. Contract EM-78-C-05-5759. 119p. Dep. NTIS, PC A06/MF A01.

The rolling cylinder provides a means for utilizing the latent heat of fusion of salt hydrates for thermal energy storage. Calorimetric tests of laboratory scale rolling cyclinders using Glauber's salt have confirmed the technical feasibility of the concept. Several concepts for large scale, one million Btu, units have been evaluated

for heat rate capability, blower and rolling power requirements, and relative cost and manufacturability. Large scale units seems technically and economically viable. Construction of a larger scale prototype is planned for the next part of this contract. The recommended size of the prototype is a two-foot diameter, nine-foot long cylinder of about 250,000 Btu theoretical capacity. An instrumented calorimeter would be constructed for testing of the cylinder. A one-year testing phase is tentatively planned as a follow-on to the present contract.

GEOTHERMAL ENERGY

13388 (DOE/RA—0043-D) **Geothermal progress monitor. Progress report No. 1.** (Department of Energy, Washington, DC (USA)). Dec 1979. 84p. Dep. NTIS, PC A05/MF A01.

Progress is reported on the following: electrical uses, direct-heat uses, drilling activities, leases, geothermal loan guarantee program, general activities, and legal, institutional, and regulatory activites. (MHR)

RESOURCE STATUS AND ASSESSMENT

USA

REFER ALSO TO CITATION(S) 13393, 13409

13389 (APL/JHU/QM—77-129-3) **Eastern Gulf Coastal Plain: a scenario for geothermal energy development.** (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Feb 1978. Contract EX-76-A-36-1008. 59p. Dep. NTIS, PC A04/MF A01.

A scenario for the development of potential geothermal resources in the Eastern Gulf Coastal Plain states of Mississippi, Alabama and Florida is explained and discussed. A description of the resources and the nature of the potential applications and energy market in this region are given. A ranking of the resources as to their energy content, potential market, etc., is described, and the assumptions and strategy used to generate the scenario are discussed. A more complete report on the detailed aspects involved in the preparation of the development scenario will be issued in the near future.

13390 (PB—296623) **Geothermal resources and technology in the United States.** (National Research Council, Washington, DC (USA). Committee on Nuclear and Alternative Energy Systems). Feb 1979. 65p. Paper copy available from: National Academy of Science, 2101 Constitution Avenue, Washington, DC. 20418 PC $5.50.

The potentials and problems of geothermal energy are examined, particularly focusing on current obstacles in the development of the geothermal industry.

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

USA

REFER ALSO TO CITATION(S) 13402, 13403, 13404, 13420

13391 (HIG—78-6) **Hydrology and geochemistry of a Hawaiian geothermal system: HGP-A.** Kroopnick, P.M.; Buddemeier, R.W.; Thomas, D.; Lau, L.S.; Bills, D. (Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics). May 1978. Contract EY-76-C-03-1093. 69p. Dep. NTIS, PC A04/MF A01.

A water quality monitoring program of the Hawaii Geothermal Project well A (HGP-A) was conducted for downhole depth samples and continuous discharge samples in 1976 to 1977. The well water was slightly saline (about 5 to 10 percent ocean water) and nearly depleted of magnesium, but contained high concentrations of silica and sulfide. The chemical composition of the well water did not vary much with depth even though the sampling reached the well bottom [approximately 1768 m (5800 feet) below sea level]. The well fluid temperature was higher than that of any Hawaii ground water; a maximum of 358°C (676°F) was recorded at the bottom of the well. The water was low in tritium but unexpectedly high in carbon-14 when compared with the surrounding ground water [sampled as cose as ~ 1609 km (1 mile) away]. Mass balance calculations involving carbon and its isotopes are consistent with a model proposing that 13 percent of recharge is from sea water. During continuous flow tests, the total well yield was 83,400 lb of steam per hour, equivalent to ~ 150 gpm with 70 percent steam and the rest water. For most constituents measured, there was a one to three day buildup period before approach to a steady state concentration. Water quality data, coupled with other measurements, indicate that the well is either poorly developed or located in a formation of low transmissivity. The moderately high rainfall and high surficial permeability allow substantial rain water infiltration. Actual subsurface water circulation is open to interpretation because of our uncertainty about geologic formations. Geophysical evidence suggests that deep dikes or intrusive bodies may be located on the ocean side of the well; such barriers would retard the encroachment of sea water into the well.

13392 (PB—295609) **Geothermal environmental impact assessment: baseline data for four geothermal areas in the United States. Interim report.** Sanyal, S.; Weiss, R. (Geonomics, Inc., Berkeley, CA (USA)). Sep 1978. Contract EPA-68-03-2468. 505p. NTIS PC A22/MF A01.

The existing data on climatology, hydrology, water chemistry, seismicity, and subsidence in the Rio Grande Rift Zone, New Mexico; The Geysers, California; the Klamath Falls, Oregon; and with special emphasis, The Imperial Valley, California are described.

13393 (RLO—1040-T1) **Geothermal resource assessment of Mount Hood. Final report.** Hull, D.A. (Oregon State Dept. of Geology and Mineral Industries, Portland (USA)). Jul 1979. Contract EG-77-C-06-1040. 414p. Dep. NTIS, PC A18/MF A01.

Five papers are included. Separate abstracts were prepared for each one. (MHR)

13394 (RLO—1040-T1, pp 5-77) **Stratigraphy and structure of the Columbia River Basalt Group in the Cascade Range, Oregon.** Beeson, M.H.; Moran, M.R. (Portland State Univ., OR). Jul 1979.

In Geothermal resource assessment of Mount Hood. Final report.

The Columbia River Basalt Group lava flows identified in the Mt. Hood area of the Oregon Cascade Range are assigned to the Grande Ronde Basalt and Wanapum Basalt formations of the Yakima Basalt Subgroup, except for three intercalated flows of Prineville chemical type. The composite section has a stratigraphic thickness of approximately 550 m and consists of 26 flows that can be separated into eight distinct geochemical and/or magnetic polarity subdivisions. Deformation began during the incursion of the Grande Ronde Basalt and is represented by NE trending folds traversing the Cascade Range which have structural relief of approximately 300 m and by an echelon NNW to NW trending folds and faults that occur from the Clackamas River area to Portland along the Portland Hills - Brothers fault trend. During this stage of deformation, thrust faults developed parallel to some of the anticlinal axes in patterns similar to those of the Columbia Plateau. Later deformation includes vertical N10W to N55W strike slip faulting, which, when considered with the fold trends, indicates a right lateral wrench system of regional magnitude. The Columbia Plateau style of deformation clearly crosses the axis of the Cascades with several of the larger folds being present in both provinces. A N30W trending fault located just west of the Salmon River separates the NE trending folds through the Cascades from the Portland Hills - Brothers wrench fault trend.

13395 (RLO—1040-T1, pp 79-136) **Geology and geochemistry of Mt. Hood volcano.** White, C.M. (Univ. of Oregon, Portland). Jul 1979.

In Geothermal resource assessment of Mount Hood. Final report.

The lavas that comprise Mt. Hood volcano can be divided on the basis of their age and modal composition into three suites: (1) the sequence of pyroxene and hornblende andesites that was erupted prior to the last glaciation and which comprise about 90% of the volcano; (2) the post-glacial hornblende dacites that were erupted primarily as hot avalanche flows from domes near the summit; and (3) the flows of olivine andesite that were erupted from several satellite vents on the flanks of Mt. Hood. New compositional data are presented for the Main-Stage lavas and the post-glacial dacites.

13396 (RLO—1040-T1, pp 137-189h) **Gravity measurements in the area of Mount Hood, Oregon.** Couch, R.; Gemperle, M. (Oregon State Univ., Corvallis). Jul 1979.

In Geothermal resource assessment of Mount Hood. Final report.

The analysis of gravity measurements at 337 stations on and about Mount Hood indicate lateral and vertical variations in the density of the flows and pyroclastics in and beneath Mount Hood. Complete Bouguer gravity anomalies indicate that the axis of Mount Hood is located on an elongate gravity high, oriented approximately N75E. Mount Hood is superimposed on a gravity low that extends from north of the mountain to the southern extent of the survey area. The gravity low suggests a north-south oriented graben-like structure. Prominent lineations in the gravity anomalies oriented approximately N23W occur both northwest and southwest of Mount Hood. A simple cone-on-a-cylinder model for the core of Mount Hood agrees with the gravity anomalies. Long wavelength anomalies suggest that undulations in the Columbia River Basalts beneath and about Mount Hood range from less than 500 m to over 1400 m above

sea level. Porosities of the average rocks which comprise Mount Hood are estimated to be approximately 20 to 30% and the density is approximately 2.27 gm/cm^3.

13397 (SAN—1093-T5) **Hawaii Geothermal Project: modelling of a volcanic island geothermal reservoir.** Cheng, P.; Lau, K.H. (Hawaii Univ., Honolulu (USA)). Sep 1978. Contract EY-76-C-03-1093. 42p. Dep. NTIS, PC A03/MF A01.

Prior to the drilling of the HGP-A well, it had generally been assumed that geothermal reservoirs on the Island of Hawaii were low-temperature liquid-dominated reservoirs which were constantly recharged from the ocean. Two numerical studies based on this conceptual model were carried out to investigate heat transfer and fluid flow characteristics in such a reservoir. It was found that (1) even under the most unfavorable conditions, i.e., in the absence of caprock for the prevention of heat loss and with constant recharge from cold seawater, it is possible to have a large amount of hot water at shallow depth, (2) the upwelling of the water table resulting from geothermal heating is small, and (3) the rate of contraction of isotherms resulting from the withdrawal of fluid from a production well depends not only on the withdrawal rate, but also on the size of the heat source and the relative location of the production well and the heat source. After the drilling of the HGP-A well had been completed in April 1976, it was found from the core samples that the permeability of the formation varies with depth, and that the low salinity of the water samples taken from the well indicates that there is a barrier between the well and the ocean, preventing the free flow of seawater. Thus, a third numerical model taking into consideration the layered structure of the formation, with recharge and discharge through an upper permeable boundary, was carried out to simulate the free convection processes at the Kapoho geothermal field. In addition, analytical studies on convective heat transfer from dikes and sills in an aquifer with high permeability have been performed, and analytical expressions for heat transfer rates and the size of the hot water zone from hot intrusives have been obtained.

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

REFER ALSO TO CITATION(S) 13393, 13769

GEOPHYSICAL TECHNIQUES AND SURVEYS

13398 (DOE/ET/28404—1) **Development of advanced electromagnetic exploration system. Final report.** (Westinghouse Electric Corp., Baltimore, MD (USA). Electronic Products and Services Div.). Aug 1979. Contract ET-78-C-07-1702. 193p. Dep. NTIS, PC A09/MF A01.

The electronics system design for both the transmitting system and the receiving system, the laboratory test results obtained on the system completed thus far, and the effort needed to complete the system are detailed. (MHR)

13399 (DOE/TIC—11062) **Geothermal ground noise measurements at Roosevelt Hot Springs and Cove Fort, Utah. Final report.** Laster, S.J.; Douze, E.J. (Tulsa Univ., OK (USA). Geophysics Lab.). Sep 1978. 94p. Dep. NTIS, PC A05/MF A01.

The present study was basically aimed at determining the type of noise found around a geothermal reservoir. Six element arrays were used to determine the structure of the noise field and the types of waves present. Arrays were used at both the Roosevelt Hot Springs and Cove Fort areas. The arrays consisted of six seismometers, one in the center and the others evenly spaced on a circle. The interelement array spacing varied from 50 m to 300 m depending on the experiment. The instrumentation and the arrays are discussed in some detail. The theory required to gain an understanding of the results is briefly discussed. (MHR)

13400 (IDO—1702-T2) **Electromagnetic exploration system. Progress report.** (Westinghouse Electric Corp., Boulder, CO (USA)). Nov 1978. Contract ET-78-C-07-1702. 109p. Dep. NTIS, PC A06/MF A01.

A design for a cost effective, highly flexible, and portable controlled source EM exploration system is presented. The design goals of the CMOS micro-processor based receiver and its companion transmitter are listed. (MHR)

13401 **Interpretation of gravity surveys in Grass and Vuena Vista Valleys, Nevada.** Goldstein, N.E.; Paulsson, B. (Univ of Calif, Lawrence Berkeley Lab). *Geothermics;* 7: No. 1, 29-50(1978).

A program of gravity measurements was initiated in Grass and Buena Vista valleys in 1975 and 1976, respectively, as part of the Lawrence Berkeley Laboratory's study of exploration techniques in geothermal exploration and assessment of potential reservoirs. The basic program had three main goals: (1) to evaluate selected geothermal reservoirs in northern Nevada on the basis of detailed geological, geochemical, and goephysical data; (2) to compare and evaluate geophysical techniques used in exploration and reservoir delineation; and (3) to develop new techniques, including necessary instrumentation, for deep exploration. Results of the gravity surveys conducted under this program are analyzed.

13402 (PB—296547) **Seismic refraction investigation of the Salton Sea Geothermal Area, Imperial Valley, California. Master's thesis.** Frith, R.B. (California Univ., Riverside (USA). Inst. of Geophysics and Planetary Physics). Dec 1978. 106p. NTIS, PC A06/MF A01.

The object of this study was to use seismic refraction to investigate the known geothermal zone and adjacent areas in preparation for energy resource development. Seven seismic refraction profiles and four long-distance refraction shots were used to investigate the Salton Sea geothermal area. From these data, two models of the geothermal and adjacent area are proposed.

13403 (RLO—1040-T1, pp 191-272) **Heat flow modeling of the Mount Hood volcano, Oregon.** Blackwell, D.D.; Steele, J.L. (Southern Methodist Univ., Dallas, TX). Jul 1979.

In Geothermal resource assessment of Mount Hood. Final report.

Some examples of simple cooling models of different shapes of magma chambers that might be associated with stratocone volcanoes are discussed. These simple models are calculated in order to investigate the effects of different geometry on the total heat transfer of the system, rate of cooling, and volcanic recurrence times necessary to keep the crust hot. A description of a detailed study of the Western Cascade-High Cascade boundary in the Western Cascade province is discussed along with the results of heat flow studies along the eastern boundary of the Northern Cascade Range of Oregon. These studies are presented for completeness and for comparison with the data obtained in the Mt. Hood region. The heat flow in the vicinity of Mt. Hood is discussed, including near-regional exploration holes, and deep exploration holes at Timberline Lodge and at Old Maid Flat at the foot of the Mt. Hood volcano.

GEOCHEMICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 13392

13404 (RLO—1040-T1, pp 273-330) **Geochemical studies of rocks, water, and gases at Mt. Hood, Oregon.** Wollenberg, H.A. (Lawrence Berkeley Lab., CA); Bowen, R.E.; Bowman, H.R.; Strisower, B. Jul 1979.

In Geothermal resource assessment of Mount Hood. Final report.

Mt. Hood, a composite andesitic volcano, located near Portland, Oregon, is one of several large eruptive centers which dominate the Cascade Mountains of the western United States. Samples of warm- and cold-spring water, water from a geothermal test well in Old Maid Flat, fumarolic gases, and rocks were collected and analyzed for major chemical constituents and trace elements. The only warm-spring area on Mt Hood is Swim Springs, located on the south flank. Orifices at Swim were sampled repeatedly with little overall change noted in water chemistry between summer and winter. Oxygen and hydrogen isotope data and mixing calculations based on analyses of Swim Springs and numerous cold springs, indicate that a large component of the warm water at Swim is from near-surface runoff. Chemical geothermometry suggests that temperatures at depth in the Swim Springs system are within the range 104 to 170°C; the temperature of unmixed hot water may exceed 200°C. A geothermal model of Mt. Hood is proposed wherein snow- and glacier-melt water near the summit comes in close proximity to the hot central neck of the mountain, manifested by the summit-crater fumaroles. The hot water migrates down-slope, mixing with cold water along its path; a small portion of the mixed warm water surfaces at Swim Springs. The platinum-group element, iridium was detected in warm and cold spring waters and in a sample of altered andesite.

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 13397, 13425

13405 (SAN—1093-T6) **Hawaii Geothermal Project. Summary report.** (Hawaii Univ., Honolulu (USA)). Sep 1978. Contract EY-76-C-03-1093. 26p. Dep. NTIS, PC A03/MF A01.

An overview of the first five years of the Hawaiian Geothermal Project and a brief report of the management and coordination activity are presented. The first three phases are: exploratory surveys, experimental drilling, and well testing and analysis. A list of publications and a chronology of events are included. (MHR)

LEGAL AND INSTITUTIONAL ASPECTS

13406 (DOE/ET/28464—1) **Geopressured-geothermal resource development on public free school lands.** (RPC, Inc., Austin, TX (USA)). Jul 1979. Contract ET-78-G-05-5958. 105p. Dep. NTIS, PC A06/MF A01.

The study's findings and recommendations are based upon analysis of the following: financial and economic feasibility of geopressured-geothermal resource development; possible ecological, social, and economic impacts of resource development on PFSL; and legal issues associated with resource development. The results of the analysis are summarized and are discussed in detail in a series of four technical papers which accompany this volume. Existing rules of the General Land Office (GLO), the School Land Board (SLB), and the Railroad Commission of Texas (RRC) were reviewed in light of the above analysis and were discussed with the agencies. The study's recommendations resulted from this analytical and review process; they are discussed. The preliminary draft rules and regulations to govern resource development on PFSL are presented in Appendix A; the accompanying forms and model lease are found in Appendix B.

13407 (DOE/ET/28464—1(Vol.1)) **Legal issues related to geopressured-geothermal resource development. Geopressured-geothermal technical paper No. 1.** (RPC, Inc., Austin, TX (USA)). Jul 1979. Contract ET-78-G-05-5958. 49p. Dep. NTIS, PC A03/MF A01.

The legal aspects of geopressured-geothermal development in Texas are discussed. Many of the legal issues associated with geopressured-geothermal development in Texas are unsettled and represent areas of developing policy and law. Lawsuits can be expected either before or shortly after the first commercial development of geopressured-geothermal resources.

13408 (DOE/ET/28464—1(Vol.3)) **Geopressured-geothermal energy development: social and economic issues. Geopressured-geothermal technical paper No. 3.** (RPC, Inc., Austin, TX (USA)). Jul 1979. Contract ET-78-G-05-5958. 53p. Dep. NTIS, PC A04/MF A01.

Information is presented relevant to rule-making for geopressured-geothermal development on state-owned lands. The analysis is focused on those potential social and economic effects of resource development, if any, which may require special attention during the leasing and permitting process. The social and economic impacts likely to result from resource development depend upon characteristics specific to the site and surrounding social and economic systems.

13409 (DOE/ID/12016—1) **Utah geothermal commercialization planning. Semi-annual progress report, January 1, 1979—June 30, 1979.** Green, S.; Wagstaff. L.W. (Utah Div. of Water Rights, Salt Lake City (USA)). 1979. Contract FC-7-79ID12016. 124p. Dep. NTIS, PC A06/MF A01.

The effects of the Utah geothermal planning project were concentrated on the Utah geothermal legislation, the Roosevelt Hot Springs time phased project plan and the Salt Lake County area development plan. Preliminary findings indicate a potential for heat pump utilization, based on market interest and the existence of suitable groundwater conditions. (MHR)

13410 (DOE/TIC—11081) **Regional hydrothermal commercialization plan.** (Department of Energy, Washington, DC (USA). Div. of Geothermal Energy; Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office; EG and G Idaho, Inc., Idaho Falls (USA); Utah Univ., Salt Lake City (USA). Research Inst.). 14 Jul 1978. 170p. Dep. NTIS, PC A08/MF A01.

This plan for the Rocky Mountain Basin and Range Region articulates the complete range of initiatives (federal, state, local, and industrial) required for the early commercialization of the regions geothermal resources. (MHR)

13411 (LA-UR—80-307) **Economics of geothermal energy.** Morris, G.E.; Tester, J.W.; Graves, G.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 12p. (CONF-800216—1). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society topical meeting; Los Angeles, CA, USA (27 Feb 1980).

A selected summary is presented of the resource, technical, and financial considerations which influence the economics of geothermal energy in the US. Estimates of resource base and levelized busbar cost of base load power for several types of geothermal resources are compared with similar estimates for more conventional energy resources. Current geothermal electric power plants planned, under construction, and on-line in the US are noted.

13412 (SAN—2121-1) **Financing geothermal resource development in the Pacific Region states.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 15 Aug 1978. Contract ET-78-C-03-2121. 55p. Dep. NTIS, PC A04/MF A01.

State and federal tax treatment as an incentive to development and non-tax financial incentives such as: the federal geothermal loan guarantee program, the federal geothermal reservoir insurance, and state financial incentives are discussed. (MHR)

13413 (SAN—2121-2) **State agency geothermal coordination in California.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 30 Nov 1978. Contract ET-78-C-03-2121. 53p. Dep. NTIS, PC A04/MF A01.

The performance of the State Geothermal Resources Board (GRB) is presented. The State Geothermal Resources Task Force of 1977 and its influence on the present setting are studied. The GRB's Technical Advisory Committee and the agencies' use of it during the current year as a focal point of their geothermal policy efforts are explored. Also explored is the possibility of California's forming a more formal mechanism for carrying out that concern. (MHR)

13414 (SAN—2121-2) **Streamlining the Federal geothermal leasing and permitting process: background papers, analysis and recommendations.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 30 Jul 1978. Contract ET-78C-03-2121. 128p. Dep. NTIS, PC A07/MF A01.

The federal leasing and permitting programs were analyzed as well as those of the five states in the Pacific Region. The relevant statutoring and regulatory frameworks of the land management agencies involved were also analyzed, as well as the options prepared by the DOE Streamlining Task Force and the California State-Federal-Local Task Group. The present stationary responsibilities and management structure of the Forest Service, BLM, and the Pacific Region States, as well as the roles of DOE and DOD. (MHR)

13415 (SAN—2121-4) **Legal and institutional problems facing geothermal development in Alaska.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 1 Oct 1978. Contract ET-78-C-03-2121. 47p. Dep. NTIS, PC A03/MF A01.

The major players and the major difficulties each presents to geothermal development in Alaska are sketched. The following are included: the Alaskan natives. the posture of the state of Alaska, and the federal lands. (MHR)

13416 (SAN—2121-6) **Legal and institutional problems facing geothermal development in Hawaii.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 1 Oct 1978. Contract ET-78-C-03-2121. 34p. Dep. NTIS, PC A03/MF A01.

The problems discussed confronting future geothermal development in Hawaii include: a seemingly insoluble mismatch of resource and market; the burgeoning land claims of the Native Hawaiian community; a potential legal challenge to the State's claim to hegemony over all of Hawaii's geothermal resources, regardless of surface ownership; resistance to any sudden, large scale influx of Mainland industry, and questionable economics for the largest potential industrial users. (MHR)

13417 (SAN—2121-7) **Legal and institutional problems facing geothermal development in Oregon and Washington.** (JM Energy Consultants, Inc., Los Angeles, CA (USA)). 1 Oct 1978. Contract ET-78-C-03-2121. 36p. Dep. NTIS, PC A03/MF A01.

The energy supply and demand picture of these two states is sketched. The perceived legal and institutional problems facing geothermal are shown against the backdrop of this broader, energy policy portrait. The following are discussed: the Bonneville Power Administration - regional power broker; other key institutional players; industrial users, public utilities, two state governments, and one regional commission; and a legal/institutional agenda for the Pacific Region team. (MHR)

ECONOMIC AND FINANCIAL ASPECTS

13418 (DOE/ET/28464—1(Vol.2)) **Economic and financial evaluation of geopressured-geothermal resource development. Geopressured-geothermal technical paper No. 2.** (RPC, Inc., Austin, TX (USA)). Jul 1979. Contract ET-78-G-05-5958. 104p. Dep. NTIS, PC A06/MF A01.

The purpose of the financial analysis was to provide the School Land Board and General Land Office of Texas with an analytical framework for analyzing the effect of leasing policies on the financial feasibility of geopressured-geothermal field development. Such an analytical framework was developed and was applied to eleven sets of development assumptions. The analytical framework, its applications, and results are discussed.

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 13042, 13392, 14158, 14190

13419 (DOE/ET/28464—1(Vol.4)) **Analysis of ecological effects of geopressured-geothermal resource development. Geopressured-geothermal technical paper No. 4.** (RPC, Inc., Austin, TX (USA)). Jul 1979. Contract ET-78-G-05-5958. 137p. Dep. NTIS, PC A07/MF A01.

The activities involved in geopressured-geothermal resource production are identified and their ecological impacts are discussed. The analysis separates those activites that are unique to geopressured-geothermal development from those that also occur in oil and gas and other resource developments. Of the unique activities, those with the greatest potential for serious ecological effect are: (1) accidental brine discharge as a result of a blowout during well drilling; (2) subsidence; (3) fault activation and enhanced seismicity; and (4) subsurface contamination of water, hydrocarbon, and mineral reservoirs. Available methods to predict and control these effects are discussed.

13420 (RLO—2229-T7-2) **Utilization of geothermal energy resources in rural Alaskan communities. Final report, June 1-December 31, 1974.** Forbes, R.B.; Leonard, L.; Dinkel, D.H. (Alaska Univ., College (USA). Geophysical Inst.). Dec 1974. Contract EY-76-S-06-2229-007. 87p. Dep. NTIS, PC A05/MF A01.

Three potential geothermal sites in Alaska are discovered. The history of previous use of the hot springs, the socio-economic factors, energy needs, and total energy utilization plans of selected Alaskan thermal springs are presented. Proposed research programs for the sites and environmental hazards and protection are described. (MHR)

13421 (SAN—2175-T1) **Northern California Power Agency Geothermal Project No. 2: draft joint environmental study.** (California Energy Commission, Sacramento (USA); Bureau of Land Management, Ukiah, CA (USA); Geological Survey, Palo Alto, CA (USA)). Nov 1979. Contract ET-78-G-03-2175. 240p. Dep. NTIS, PC A11/MF A01.

The following are included: project description, environmental setting, environmental impacts and mitigation measures, project alternatives and a summary of environmental consequences. (MHR)

13422 (RLO—1830-T4) **Removal of H_2S from geothermal steam. Semi-annual report, April 1-October 31, 1975.** Li, C.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). [nd]. Contract EY-76-C-06-1830. 28p. Dep. NTIS, PC A03/MF A01.

The program objective is to identify and evaluate a technique to remove hydrogen sulfide from geothermal steam before it is used for power generation. The last six months were spent in the literature search, sorbent preparation and evaluation, and construction of an experimental apparatus. Zn0, mentioned in the original proposal as a good candidate for H_2S adsorption, was verified as such by the literature search and laboratory experiments. However, regeneration of sulfided sorbent proved to be difficult. The interests were, then, switched to formulating sorbents made of mixtures of different kinds of metal oxides. At present, two sorbents were formulated which, when evaluated with a gas adsorption apparatus in the laboratory, possess better H_2S adsorption-regeneration capabilities than Zn0 or sorbents obtained from catalyst manufacturers. Large-scale gas adsorption equipment for use with simulated geothermal steam has been designed, built and shakedown operation of the equipment is in progress.

GEOTHERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 13411, 13421, 13522

POWER PLANT SYSTEMS AND COMPONENTS

REFER ALSO TO CITATION(S) 13787

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

13423 (BNL—51048) **Cementing of geothermal wells. Progress report No. 12, January-March, 1979.** (Brookhaven National Lab., Upton, NY (USA)). Aug 1979. Contract EY-76-C-02-0016. 142p. Dep. NTIS, PC A07/MF A01.

Work to implement the program plan for the development of improved high temperature cementing materials for geothermal wells is continuing. Results from initial tests in the Dynamic Brine Exposure Testing Apparatus (D-BETA) are available. Based upon initial data, the rate at which cement coupons undergo change in the D-BETA is between that of the static tests and the dynamic exposures at East Mesa. Several cementing compositions have been formulated with chemical, physical and mechanical properties to withstand the existing geothermal conditions. The pumpability of three formulations has been demonstrated and the materials have been submitted to NBS for additional evaluation. The effect of Al_2O_3, Fe_2O_3, SO_3, Na_2CO_3 and Na_2SO_4 on different binders were studied at Colorado School of Mines. The results were found to range from deleterious to beneficial. Phosphate-bonded cements have been produced at the University of Rhode Island from a glass containing 7% Na_2O, 24% CaO, 24% Al_2O_3 and 45% SiO_2. Preliminary tests indicate that the material sets in several hours and appears to have some high temperature stability. Tests performed on hydrothermal cements indicate six formulations that are pumpable as long as three hours at 316°C. Two formulations, Al_2O_3 and ZrO_2, have been chosen for use at temperatures above 300°C. Polymer concentrates containing cement fillers have been found to be hydrothermally stable in 300°C brine. Recommended standards for evaluating geothermal well cements have been developed by NBS. (MHR)

13424 (CONF-7806141—, pp F1-F10) **The drilled hole.** Taylor, D.F. (Otis Engineering Corp., Dallas, TX). Apr 1979.

From Technical seminar on geothermal seals; Boston, MA, USA (27 Jun 1978).

The basic drilled hole and the associated language used by the oil industry are reviewed, covering the development of a producing geothermal hole, such as cementing and packing-off unproductive zones, problems of pipe tolerances, excessive clearances requiring sealing, and possible approaches to overcome these problems. (MHR)

13425 (COO—2817-T1) **Geothermal down-well instrumentation (during drilling). Final report.** Kent, W.H.; Mitchell, P.G.; Row, R.V. (Sperry Research Center, Sudbury, MA (USA)). Jun 1979. Contract EY-76-C-02-2817. 188p. Dep. NTIS, PC A09/MF A01.

The object of the work was to investigate acoustic and electromagnetic telemetry methods which could be used as a basis for geothermal MWD systems. The emphasis has been on methods which employ the drill string and/or the formation surrounding the borehole as a signalling media. The investigations have been confined to the transmission characteristics of these media and have excluded the area of downwell measurements. Work performed includes: laboratory measurement of acoustic attenuation in drill pipe; field measurement of acoustic attenuation in drill pipe; measurements of drill string vibrations (drilling noise) during drilling; evaluation of drill string vibration dampers; modeling of electromagnetic propagation in the borehole region; and field measurements of attenuation of a downwell electromagnetic signal source. (MHR)

13426 (SAND—79-1756C) **Geothermal drilling research in the United States.** Varnado, S.G.; Maish, A.B. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 12p. (CONF-800102—2). Dep. NTIS, PC A02/MF A01.

From International conference on geotechnical and environmental aspects of geopressure energy; Sea Island, GA, USA (13 Jan 1980).

The high cost of drilling and completing geothermal wells is an impediment to the development of this resource. The Department of Energy (DOE), Division of Geothermal Energy (DGE), is conducting an R and D program directed at reducing well costs through improvements in geothermal drilling and completion technology. This program includes R and D activities in high temperature drilling hardware, drilling fluids, lost circulation control methods, completion technology, and advanced drilling systems. An overview of the program is presented.

13427 (SAND—79-2398) **Geothermal drilling and completion technology development program. Quarterly progress report, October-December 1979.** Varnado, S.G. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 130p. Dep. NTIS, PC A07/MF A01.

The progress, status, and results of ongoing Research and Development (R & D) within the Geothermal Drilling and Completion Technology Development Program are described. The program emphasizes the development of geothermal drilling hardware, drilling fluids, and completion technology. Advanced drilling systems are also under development. The goals of the program are to develop the technology required to reduce well costs by 25% by 1982 and by 50% by 1986.

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 13424

13428 (CONF-7806141—) **American Society for Testing and Materials Task Group on Geothermal Seals: proceedings of technical seminar.** (American Society for Testing and Materials, Philadelphia, PA). Apr 1979. Contract ET-78-G-01-3215. 190p. Dep. NTIS, PC A09/MF A01.

From Technical seminar on geothermal seals; Boston, MA, USA (27 Jun 1978).

Eight papers are included. A separate abstract was prepared for each one. Summaries are included of group discussions on:

development of test facilities, standardization of test seal configurations, polymer screening procedures, and elastomers. (MHR)

13429 (CONF-7806141—, pp D1-D8) **Some examples of US geothermal development activities.** Reeber, R.R. (Dept. of Energy, Washington, D.C.). Apr 1979.

From Technical seminar on geothermal seals; Boston, MA, USA (27 Jun 1978).

Both government funded and privately funded geothermal activities are reviewed briefly including some success areas and technological breakthroughs on items such as minerals build-up removal. (MHR)

13430 (CONF-7806141—, pp E1-E4) **Review of DOE funded elastomer programs.** Cassidy, P.E. (Texas Research Inst., Austin). Apr 1979.

From Technical seminar on geothermal seals; Boston, MA, USA (27 Jun 1978).

Government funded development programs on elastomers for service in a geothermal environment are reviewed covering work performed by four major DOE subcontractors. (MHR)

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

13431 (DOE/ET/28301—1) **Capabilities to measure geothermal material properties at simulated in situ conditions. Final report.** Enniss, D.O.; Butters, S.W.; Lingle, R.; Van Buskirk, R.G.; Prater, F.R. (Terra Tek, Inc., Salt Lake City, UT (USA)). Jul 1979. Contract EG-77-C-07-1650. 82p. Dep. NTIS, PC A05/MF A01.

The lack of reservoir material property data has been identified as a major obstacle to geothermal development and commercialization. To meet this need a high pressure/high temperature test facility was designed and constructed at Terra Tek under Department of Energy funding. Testing capabilities include confining and pore fluid pressure to 200 MPa and temperatures to 535°C. Rock samples to 10.2 cm diameter can be accommodated. The program summarized herein is the second year (October 1977-September 1978) effort. Test techniques were developed to meet the geothermal community needs and tests were conducted to determine: mechanical properties, thermal conductivity, thermal diffusivity, thermal expansion, permeability, electrical resistivity and ultrasonic velocities. Sandstones, graywackes, granites, and basalts, from KGRA's in Baca, New Mexico; Milford, Utah; Geysers, California and Northern Nevada, respectively were characterized.

13432 (LBL—9056(Rev.)) **Numerical model of transient two-phase flow in a wellbore.** Miller, C.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 31p. Dep. NTIS, PC A03/MF A01.

Transient two-phase flow in a geothermal well has been modelled with a finite-difference approximation. One-dimensional flow is assumed. The equations of mass, momentum, and energy are solved using a partially implicit method. Terms that would place a severe time restriction on the calculation are solved implicity, while other terms are solved explicitly for computational ease and efficiency. Homogenous flow of one component at thermodynamic equilibrium is assumed initially, but the extension of the model to include slip and a finite rate of condensation or evaporation or a noncondensible gas is given. The wellbore model includes heat and mass transfer and is coupled to a simple reservoir model. Using the model, the transient behavior of a single- or two-phase well during a well test was investigated. Results show that when the reservoir has a relatively large value of kh, as exists in a geothermal field, the slope of the log (pressure) vs log (time) curve is not necessarily a unit slope when testing a homogenous reservoir. The early-time behavior of this curve is controlled by the interaction of the flow in the reservoir and that in the well, and can be used to determine near bore values of kh. Heat loss in the wellbore is shown to also affect the pressure vs time plot in a well test. The time to reach the pseudo steady region increases when heat transfer is important, even in a relatively warm well, and the slope of the P vs log t curve is no longer $q\mu/4\pi kh$ as derived in the petroleum literature.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

REFER ALSO TO CITATION(S) 13434

DIRECT ENERGY UTILIZATION

13433 (CONF-800210—1) **Geothermal direct use projects.** DiBello, E.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract EY-76-C-07-1570. 22p. Dep. NTIS, PC A02/MF A01.

From IEEE Region 6 conference; San Diego, CA, USA (20 Feb 1980).

The early commercialization of hydrothermal energy is being aided by the implementation of demonstration projects that are funded on a cost sharing basis by the Department of Energy. A total of twenty-two projects designed to demonstrate the technical and economic feasibility of the direct use of geothermal fluids are presently underway in the United States. The type and complexity of these projects vary from space heating and grain drying to food processing. By encouraging further geothermal development, environmental, technical, operational and economic information will be generated that will assist the near-term commercialization of this valuable resource.

13434 (DOE/ET/28469—4) **Performance and feasibility of forced geoheat recovery for low temperature applications. Final report, April 1, 1978-June 30, 1978.** Bodvarsson, G.; Reistad, G.M. (Oregon State Univ., Corvallis (USA)). 1978. Contract EY-76-S-06-2227-036. 198p. (RLO—2227/T36-4). Dep. NTIS, PC A09/MF A01.

Forced geoheat recovery (FGR) resources and production technology are reviewed. Utilization of geothermal fluids in the temperature range 15°C to 150°C for building heating and industrial purposes is covered. Results on the technoeconomic feasibility of FGR systems to supply energy for building heating are summarized. (MHR)

13435 (IDO—1540-T2) **Idaho geothermal development projects. Annual report for 1976.** (Idaho National Engineering Lab., Idaho Falls (USA)). 1976. Contract EY-76-C-07-1540. 39p. Dep. NTIS, PC A03/MF A01.

A third successful well in Raft River was completed, to 6000 ft, striking a 149°C (300°F) reservoir, at less cost than either of the other two wells, despite being drilled in a formation of lower productivity. This well employed a special multiple channel drilling technique, which in retrospect was necessary to make the well useful for production of fluids. Two successful wells of shallow depth (1200 ft) were also finished in Boise this summer, both producing artesian flows of the predicted temperature, 75°C (167°F). The sources in tapping both the Raft River and Boise geothermal reservoirs was followed by an extensive reservoir monitoring program. By-product uses of the Raft River geothermal water received season long testing for irrigation of crops and for fish culture. Both results were highly encouraging. In Boise, the success of the two shallow wells and some design innovations lead to the conclusion that providing geothermal space heat to the capitol and other state-owned buildings could be a major economic success if double or triple the number of buildings could be served. (MHR)

13436 (N—79-26531) **Geothermal heating with heat pumps le chauffage geothermique avec pompe a chaleur.** (Electricite de France, 78 - Chatou). 1978. 16p. NTIS, PC A02/MF A01.

The application of geothermal energy conversion to heating is described. One class of heat pumps was analyzed. Their coupling with a geothermal source allows for satisfactory heating. Performances are given. Particular attention is paid to optimal utilization given the external temperature.

13437 (SAN—1329-4(Vol.1)) **Direct use applications of geothermal resources at Desert Hot Springs, California. Final report, May 23, 1977-July 31, 1978. Volume I: summary of findings.** Christiansen, C.C. (Desert Hot Springs, City of, CA (USA)). Jul 1978. Contract EG-77-C-03-1329. 65p. Dep. NTIS, PC A04/MF A01.

The geothermal resources underlying the City of Desert Hot Springs were described in terms of anticipated geophysical, geochemical, and hydrological characteristics, based upon existing well log data, geologic surveys, and limited wellflow tests. The needs of the City were determined on the basis of its general plan, the City's 1976 census, load survey and a public acceptance survey. Then a broad range of potential nonelectric applications was surveyed in individual as well as energy cascading systems to identify the matchup of the resource and needs of the city. Applications investigated included space conditioning, space/water heating, car wash, agriculture/horticulture, and aquaculture operations. The list of applications so derived was assessed in light of technological, socio-economic, environmental, institutional, and market considerations to determine target opportunities for DHS as well as on a broad regional basis. Those systems which survived the initial screening were subjected to detailed parametric studies focused on determining tradeoffs among performance, cost, size, compatibility with off-the-shelf hardware, etc. A detailed analysis of the engineering and economic aspects of the most promising systems was then performed. Factors considered included technological problems and risks, status of supporting technologies, net energy ratios, costs, market, displacement of fossil fuels, and economic benefit to the community.

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 13431, 14444

TIDAL POWER

REFER ALSO TO CITATION(S) 13340

WAVE ENERGY CONVERTERS

REFER ALSO TO CITATION(S) 13340

13438 (ORO—5669-T2) **Protonic conduction wave energy converter. Final report, January 1, 1978-December 31, 1978.** Salomon, R.E. (Temple Univ., Philadelphia, PA (USA). Dept. of Chemistry). Feb 1979. Contract ET-78-S-05-5669. 83p. Dep. NTIS, PC A05/MF A01.

An initial study of the feasibility of using electrochemical hydrogen concentration cells with protonic conductors for the conversion of ocean wave energy into electricity has been carried out. The system considered uses the potential energy of waves or ocean swells to alternately compress and expand hydrogen gas which thereby drives a concentration cell. A theoretical analysis of four idealized embodiments of the device, incorporated within a taut-moored buoy, has shown that the key to efficient conversion is sufficiently low electrode and electrolyte resistance. One of the pivotal assumptions in this analysis is that the system can respond in the time of an ocean wave period to the pressure oscillations. Accordingly, this assumption was tested experimentally using Nafion and filter paper impregnated with hydrochloric acid as the electrolytes and platinum as the electrode material. The assumption was experimentally validated and the power delivered by these cells under conditions of simulated three foot waves was measured as a function of load resistancy and temperature. The power exhibited a peak as a function of load resistance, increased with a rise in temperature and sharply increased with an enhancement of the water content of the Nafion. The two latter observations are indicative of the importancy of low cell resistance in achieving high conversion efficiencies. By combining the experimental results on power and cell resistance with results of the theoretical analysis of a potential system it is concluded that 250 watts can be obtained from one square meter of ocean in a three foot sea. This 25% conversion efficiency can be obtained with presently available materials (Nafion and porous platinum electrodes.)

13439 (PB—293603) **An experimental study and engineering evaluation of the Salter cam wave energy converter.** Carmichael, A.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Ocean Engineering). Dec 1978. 80p. NTIS, PC A05/MF A01.

An experimental study and an engineering evaluation of the Salter cam wave energy device has been conducted. The experiments were carried out with a model cam placed in a wave channel and in a towing tank. The tests in the towing tank were with a floating model to simulate ocean conditions. The experimental results indicated that the Salter cam was capable of extracting much of the energy in regular waves and confirmed Salter's findings. From the engineering evaluation it was concluded that there are major unsolved problems associated mainly with the mooring system. The predicted cost of electricity brought to the shore was much higher than costs predicted for more conventional methods of electrical power production during the 1990's.

WIND ENERGY

13440 (NASA-CP—2106, pp 363-374) **Results of a utility survey of the status of large wind turbine development.** Watts, A. (Hydro-Quebec, Montreal, Canada); Quraeshi, S.; Rowley, L.P. 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

A survey of the status of wind turbine development has been commissioned by a utility company having interest in the application of wind power to the generation of electricity. The utility, Hydro-Quebec, is considered one of the major utilities in North America in that it services one of the largest geographical land masses in the continent. An indication of the scope of the utility is given.

13441 (NASA-CP—2106, pp 375-384) **Simulation studies of multiple large wind turbine generators on a utility network.** Gilbert, L.J. (Lewis Research Center, Cleveland, OH); Triezenberg, D.M. 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The Wind Energy Project Office of NASA-Lewis has undertaken, as part of the Department of Energy wind program, a multifaceted project to study the anticipated performance of a cluster of wind turbine generators on an electric utility network. Both in-house and contractor resources are being used. Preliminary results of an in-house simulation of two Mod-2 systems tied to an infinite bus indicate favorable system performance.

13442 (NASA-CP—2106, pp 385-395) **System configuration improvement.** Doman, G.S. (Hamilton Standard, Windsor Locks, CT). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The design of a wind turbine generator is a very complex process because of the many (and often conflicting) choices and considerations involved. As a consequence, the determination of a superior system can best be achieved from intensive studies and probings that reflect the truly pertinent governing factors. A discussion of such a process in terms of word charts and associated figures is presented.

13443 (WASH—2330-78/4(Vol.1)) **Design study and economic assessment of multi-unit offshore wind energy conversion systems application. Volume I. Executive summary. Final report.** Kilar, L.A. (Westinghouse Electric Corp., East Pittsburgh, PA (USA)). 14 Jun 1979. Contract EX-76-C-01-2330. 59p. Dep. NTIS, PC A04/MF A01.

Information in presented concerning meteorological and oceanographic surveys of the US offshore; apparatus designs and costs; and OWECS system economics.

AVAILABILITY (CLIMATOLOGY)

REFER ALSO TO CITATION(S) 13488, 13716, 13717

13444 (DOE/ET/20283—1) **Statistical models for wind characteristics at potential wind energy conversion sites. Final report, September 15, 1977-October 14, 1978.** Corotis, R.B. (Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering). Jan 1979. Contract EY-76-S-06-2342. 86p. (RLO—2342-79/1). Dep. NTIS, PC A05/MF A01.

Simple models and guidelines are developed for wind energy site surveys. Probabilistic procedures are employed to assess survey duration, climatological adjustment, and run duration statistics. A climatological adjustment procedure is derived for the enhancement of candidate site data from a reference site with long-term data, and the computation of confidence intervals is shown for existing data and for projected survey durations. The value of the enhancement procedure is diminished because of the sensitivity of the procedures to long-term cross correlations. A simplified run duration model is developed for initial persistence assessment. The model is simply calibrated for each run level from the seasonal mean wind speed at a site.

13445 (NASA-CP—2106, pp 1-23) **Overview of Federal Wind Energy Program.** Ancona, D.F. (Dept. of Energy, Washington, DC). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

A brief overview is presented of what the Federal Wind Program is today, what the objectives are, and what strategies are being followed. Some of the changes in the program structure and some of the additions to the program are also included. Mention is made of upcoming organizational changes, and some budget items are covered, with particular mention of some recent significant events regarding new approvals.

13446 **Windpower potential of the northwest region.** Baker, R.W. (Oreg State Univ, Corvallis). *Power Eng.;* **83**: No. 6, 64-67(Jun 1979).

Results of a simulated wind turbine generator network study indicate that sufficient wind is available in the Bonneville Power Administration service area to successfully operate large wind turbine generator (WTG) units in the 2 MW-4 range. The monthly zero output time varied from 0.1% to 7.4% for the network and averaged from 10.0% to 78.0% at individual stations. The longest continuous network outage for a single day was 8 hours and the average downtime, when there was zero network power output, was 3.5 hr. If this lack of wind could be construed as a forced outage, the base load capability of the WTG network would not be zero. Distributing the turbines over a larger area would most likely further reduce the chance of zero network output.

ECONOMICS

REFER ALSO TO CITATION(S) 13483

13447 (DOE/SEA—1109-20401/79/2) **Wind energy applications in agriculture: executive summary. Final report.** David, M.L.; Buzenberg, R.J.; Glynn, E.F.; Johnson, G.L.; Shultis, J.K.; Wagner, J.P. (Development Planning and Research Associates, Manhattan, KS

(USA)). Aug 1979. Contract EX-76-A-29-1026. 209p. Dep. NTIS, PC A10/MF A01.

This report presents an assessment of the potential use of wind turbine generator systems (WTGS) in US agriculture. In particular, this report presents the number of WTGS's economically feasible for use in US agriculture and the conditions which yielded economic feasibility of WTGS's for certain agricultural applications. In addition, for each case, i.e., set of assumed conditions, under which WTGS's were found to be economically feasible, this report identifies (1) the agricultural WTGS applications in terms of location, type and size (complete farm and dedicated-use applications); (2) the number of WTGS's by wind machine and generator size category; (3) aggregate energy conversion potential; and (4) other technical and economic WTGS performance data for particular applications. This report also describes the methodology, data and assumptions used for the analysis. A major part of the study was the development and use of a rigorous analytical system to assess an application's wind power generation and use potential.

13448 (NASA-CP—2106, pp 397-402) **Cost of energy evaluation.** Hasbrouck, T.M. (Hamilton Standard, Windsor Locks, CT). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The cost of energy of a wind turbine generator system contains the three-elements of Capital Cost, Operation and Maintenance Cost, and Energy Capture. Evaluating the design parameters of a wind power plant utilizing these cost factors is presented.

WIND ENERGY ENGINEERING

13449 **Wind power through kites.** Goela, J.S. (Phys Sci Inc, Woburn, Mass). *Mech. Eng.;* **101**: No. 6, 42-43(Jun 1979).

It is proposed to use kites to extract energy from the wind. In addition to avoiding the use of high-capital-cost components such as towers and large rotors, the important advantage of using the proposed scheme is that it utilizes the full available potential of the wind. The motion of air generates a pull in the rope that holds the kite. This pull is a function of both the angle of attack of the kite and the kite area normal to the wind direction, and by varying any of these the pull on the rope is varied. On the surface of the earth, this rope will be suitably connected to an energy system which will convert the variation in developed force on the rope into the rotational energy of a rotor. A detailed theoretical analysis of the proposed technique has been carried out. This analysis indicates that the proposed scheme is scalable, the drag on the kite string is small in comparison to the pull in the string for large devices, and that approximately 0.38kW of power can theoretically be obtained from a kite 1 m;sup 2; in area. Even though it is difficult to estimate the cost of wind power from the proposed scheme, a rough estimate indicates that for a 100-kW system, the capital cost per unit of energy from the proposed scheme will be less--approximately by a factor of 3--in comparison with the capital cost of one unit of energy produced from other 100-kW wind energy systems. The most important application of kite-based energy systems is in developing countries where these systems can be used to pump water from wells, grind grain, and generate electricity.

APPLICATIONS

REFER ALSO TO CITATION(S) 13447

TURBINE DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 13445

13450 (DOE/NASA/0600—79/1) **Design, fabrication, test, and evaluation of a prototype 150-foot long composite wind turbine blade.** Gewehr, H.W. (Kaman Aerospace Corp., Bloomfield, CT (USA)). Sep 1979. Contract EX-76-A-29-1028. 138p. (NASA-CR—159775). Dep. NTIS, PC A07/MF A01.

The design, fabrication, test, and evaluation of a prototype 150-foot long composite wind turbine blade are described. The objective of the program was to develop the engineering and fabrication technology for blades in this unprecedented size range having the potential for low cost fabrication in production quantities. The major part of the engineering effort on this project was devoted to structural design and material selection which are compatible with low cost fabrication methods and objectives.

13451 (DOE/NASA/1010—79/5) **Preliminary analysis of performance and loads data from the 2-megawatt Mod-1 wind turbine generator.** Spera, D.A.; Viterna, L.A.; Richards, T.R.; Neustadter, H.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. Contract EX-76-A-1010-005. 15p. (NASA-TM—81408). Dep. NTIS, PC A02/MF A01.

The DOE/NASA Mod-1 wind turbine generator installed on Howard's Knob near Boone, North Carolina, was dedicated on July 11, 1979. With a rated power of 2 MW and a rotor diameter of 61 meters, the Mod-1 is the largest wind turbine ever constructed. Initial operation during August, September, and October of 1979 has produced preliminary test data on output power versus wind speed, rotor blade loads, system dynamic behavior, and start/stop characteristics. These data have been analyzed statistically and are compared with design predictions of system performance and loads.

13452 (DOE/NASA/1028—79/25) **Aeroelastic equations of motion of a Darrieus vertical-axis wind-turbine blade.** Kaza, K.R.V.; Kvaternik, R.G. (Toledo Univ., OH (USA); National Aeronautics and Space Administration, Langley AFB, VA (USA). Langley Research Center). Dec 1979. Contract EX-76-A-31-1028. 58p. (NASA-TM—79295). Dep. NTIS, PC A04/MF A01.

The second-degree nonlinear aeroelastic equations of motion for a slender, flexible, nonuniform, Darrieus vertical-axis wind-turbine blade which is undergoing combined flatwise bending, edgewise bending, torsion and extension are developed using Hamilton's principle. The blade aerodynamic loading is obtained from strip theory based on a quasi-steady approximation of two-dimensional incompressible unsteady airfoil theory. The derivation of the equations has its basis in the geometric nonlinear theory of elasticity and the resulting equations are consistent with the small deformation approximation in which the elongations and shears (and hence strains) are negligible compared to unity. These equations are suitable for studying vibrations, both static and dynamic aeroelastic instabilities, and dynamic response. Several possible methods of solution of the equations, which have periodic coefficients, are discussed.

13453 (DOE/NASA/5906—79/1) **Evaluation of feasibility of prestressed concrete for use in wind turbine blades.** Lieblein, S.; Londahl, D.S.; Furlong, D.B.;Peery, D.J.; Dreier, M.E. (Technical Report Services, Rocky River, OH (USA); Tuthill Pump Co. of California, San Rafael (USA); Paragon Pacific, Inc., El Segundo, CA (USA)). Sep 1979. Contract EX-76-A-29-1028. 120p. (NASA-CR—159725). Dep. NTIS, PC A06/MF A01.

As a part of the DOE/NASA research program on wind energy, a preliminary evaluation was conducted of the feasibility of the use of prestressed concrete as a material for low-cost blades for wind turbines. A baseline blade design was achieved for the DOE/NASA MOD-O 100 kW experimental wind turbine that met aerodynamic and structural requirements. Calculated blade weight and cost were 4900 lb and around $18,000, compared to 2000 lb and around $200,000 for a MOD-O aluminum blade. Significant cost reductions were indicated for volume production. Casting of a model blade section showed no fabrication problems. Coupled dynamic analysis revealed that adverse rotor-tower interactions can be significant with heavy rotor blades. Design options are discussed. Areas of further investigation are identified to verify the design approach and to provide the property data base required for concrete blade design.

13454 (NASA-CP—2106) **Large wind turbine design characteristics and R & D requirements.** Lieblein, S. (ed.). (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1979. 464p. (CONF-7904111—). Dep. NTIS, PC A20/MF A01.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

Separate abstracts are included for each of the 29 papers presented concerning the development states of large wind turbines, and wind turbine blade design characteristics and operating experience.

13455 (NASA-CP—2106, pp 25-33) **Design evolution of large wind tubine generators.** Spera, D.A. (Lewis Research Center, Cleveland, OH). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The design of large wind turbines of the horizontal-axis type has evolved rapidly during the past five years. Major changes have taken place in the structural and mechanical features of second generation wind turbines like the 2.5 MW Mod-2, compared with first generation machines like the 200 kW Mod-0A and 2.0 MW Mod 1. These changes have reduced the projected cost of electricity produced by second generation wind turbines to one-half that of first generation systems. To show the scope and nature of recent changes in wind turbine designs, developments of three types are described: (1) system configuration developments; (2) computer code developments; and (3) blade technology developments. Developments in system configuration are shown by direct comparison of Mod-2 components with equivalent elements in the earlier Mod-0A system.

13456 (NASA-CP—2106, pp 35-59) **General Electric Mod-1 turbine generator program.** Poor, R.H.; Hobbs, R.B. (General Electric Co., Valley Forge, PA). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The Mod-1 WTG is the first megawatt class machine in the national wind program. The Mod-1 Program which started in September of 1976 has as its objectives the design, fabrication, installation and test of a megawatt class wind turbine generator (WTG) which generates utility grade electrical power. The program is nearing the final phase of installation and checkout. The blades are the only components remaining to be installed. NASA-LeRC is managing the Mod-1 Program for DOE. General Electric's Space Division located in Valley Forge, PA., is the prime contractor, with several GE electrical equipment product departments supplying components ranging from switchgear to the synchronous generator.

13457 (NASA-CP—2106, pp 61-78) **Boeing Mod-2: wind tunnel system rated at 2.5 MW.** Douglas, R.R. (Boeing Engineering and Construction Co., Seattle, WA). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The Mod-2 project is an approximate 36 month program for the development, design, fabrication, installation, and check-out of a wind turbine system (WTS) optimized for commercial production of power into a utility grid. Similar to the Mod-0 and Mod-1 programs, Mod-2 is managed by NASA-LeRC. Contrary to those programs, the primary objective of the end hardware is for direct and efficient commercial applicaton, rather than for Research and Development. The program has been structured to achieve this desired commercial objective by a substantial concept selection effort, comparatively few firm requirements imposed on the contractor, and encouragement of commercial practice application. A summary description of Mod-2 development and of the resulting system hardware is presented.

13458 (NASA-CP—2106, pp 79-88) **WTG energy systems' MP1-200: 200 kilowatt wind turbine generator.** Spaulding, A.P. Jr. (WTG Energy Systems, Inc., Buffalo, NY). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The areas to be discussed are related to the preliminary design criteria as utilized on the MP1-200. The significance of these design criteria are based on the fact that the MP1-200 is the only wind turbine in operation today that is producing synchronous alternating current using a fixed pitch rotor configuration. The MP1-200 is installed on Cuttyhunk Island, Massachusetts as part of the Island's independent utility grid system.

13459 (NASA-CP—2106, pp 89-102) **Specification, siting and selection of large WECS prototypes.** Hugosson, S. (National Swedish Board for Energy Source Development, Spanga, Sweden). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The Swedish Wind Energy Programme was started in 1974 with preliminary feasibility studies. These indicated that wind power could become an economic reality in Sweden, and that the technical problems would not be unsurmountable. This led to a decision by NE in 1975 to design and install a Wind Power Research Unit to study the technical problems associated with wind power at a semi-scale level. The contract for this Unit was given to Saab-Scania Co. The Unit was operative in April 1977, underwent delivery tests and debugging during 1977 and began giving test data for the aluminium blade/rigid hub combination late in 1977. That combination accumulated 846 hours of operation before the hub was changed in May 1978. The combination aluminium blade/flapping hub is now operative, accumulating about 1200 hours in early April 1977, total hours of operation now being above 2000. Rotor blades will be changed into a GRP-set in May 1979, and late in 1979 into a CRP + GRP - set with increased diameter (24 m).

13460 (NASA-CP—2106, pp 103-120) **Danish Large Wind Turbine Program.** Pederson, B.M. (Technical Univ. of Denmark, Lynby). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

A short account of the Danish wind energy program and its present status is given. Results and experiences from tests on the Gedser windmill (200 kW) are presented. The key results are presented from the preliminary design study and detailed design of two new WECS (630 kW each). These two new WECS are planned to go into operation in mid-1979. The Tvind project (2 MW) is briefly mentioned.

13461 (NASA-CP—2106, pp 121-131) **Large wind energy converter: GROWIAN 3 MW.** Koeber, F.; Thiele, H.A. (M.A.N. New Tech., Munich, Germany). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The large wind energy converter GROWIAN has the function of producing electrical energy from the natural movements of the wind. A two-blade rotor mounted on the tower is rotated by the action of wind and transfers its power via a gearbox to a generator. The electrical energy thus obtained is then fed directly into the existing supply network. The plant was designed with reference to a plant site in the North German coastal area. The design of the plant permits a long-term optimal exploitation of wind energy through the use of advanced, proven engineering techniques.

13462 (NASA-CP—2106, pp 133-141) **Characteristics of future vertical axis wind turbines (VAWTs).** Kadlec, E.G. (Sandia Labs., Albuquerque, NM). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

As a DOE facility, Sandia Laboratories is developing Darrieus VAWT technology whose ultimate objective is economically feasible, industry-produced, commercially marketed with energy systems. The first full cycle of development is complete, and resulting current technology designs have been evaluated for cost-effectiveness. First-level aerodynamic, structural, and system analyses capabilities have evolved during this cycle to support and evaluate the system designs. The characteristics of current technology designs and their cost-effectiveness are presented. Potential improvements identified in this first cycle are also presented along with their cost benefits.

13463 (NASA-CP—2106, pp 143-154) **Design characteristics of the 224 kW Magdalen Islands VAWT.** Templin, R.J. (National Research Council of Canada, Ottawa, Ontairo). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The evolution of the main design features of the Magdalen Islands VAWT is described. The turbine has a rotor height of 120 ft (36.58m) and diameter 80 ft (24.38m). It was operated as a joint project between NRC and Hydro-Quebec in grid-coupled mode from July 1977 to July 1978 when the rotor was destroyed in an accident. The accident, although unfortunate, tested the basic integrity of the design in a gross overspeed condition, and the rotor is being rebuilt with minor modifications. Some directions for future VAWT research are suggested.

13464 (NASA-CP—2106, pp 155-171) **Alcoa wind turbines.** Ai, D.K. (Alcoa Labs., Alcoa Center, PA). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The Alcoa wind energy program, initiated in 1975, began with the fabrication of turbine blades, and two years later broadened its scope to the design and fabrication of complete systems of Darrieus-type vertical-axis wind turbine. Alcoa's interest in blade fabrication is natural, as the extrusion process is uniquely suited to the production of all-aluminum blades with constant chord.

13465 (NASA-CP—2106, pp 173-184) **Test results of the DOE/Sanida 17 meter VAWT.** Nellums, R.O.; Worstell, M.H. (Sandia Labs., Albuquerque, NM). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The DOE/Sandia 17 meter wind turbine began collecting operational data on March 29, 1977. Since then, operation has been conducted on a variety of rotor and drive train configurations. The present log of over 530 hours is an important means of validating theoretical calculations and providing operating experience. A brief review is presented of the test program followed by a presentation of the performance results and their significance. Then, in order to provide the reader with an appreciation of the 17 meter operating experience, a discussion of the operational difficulties occurring since the first turn 2 years ago is included.

13466 (NASA-CP—2106, pp 185-192) **Overview of vertical axis wind turbine (VAWT) blade design procedures.** Sullivan, W.N. (Sandia Labs., Albuquerque, NM). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The design of a VAWT blade section involves primarily the selection of a manufacturing technology, establishing structural integrity, and obtaining acceptable aerodynamic performance. A survey is presented of the practices which have been applied for designing VAWT blades in the past. An attempt is made to discuss strengths and weaknesses of the existing procedures. Where appropriate, discussion is provided on planned or suggested future work in developing improved design tools.

13467 (NASA-CP—2106, pp 193-204) **Fabrication of extruded vertical axis turbine blades.** Craig, A.G. Jr. (Alcoa Technical Marketing Div., Alcoa Center, PA). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

An important component of the modern Darrieus type vertical axis wind turbine is the extruded aluminum blade. This is made possible by the requirement that they be hollow, of constant airfoil shaped cross section, and be capable of being bent into a near-

troposkein shape about the flatwise axis. They should be light weight, strong, and need a minimum of maintenance. These characteristics describe some important attributes of aluminum alloy extrusions. Alcoa initiated its wind energy program in 1976 with the fabrication of extrusions for Kaman Aerospace, who furnished the original NACA 0012 53.3 cm (21 in.) chord blades for Sandia Laboratories' 17 m research VAWT. A typical section of these blades contains a D-shaped nose extrusion and vee-shaped trailing edge extrusion. Honeycomb provides the filler for the balance of the blade section, and the assembly is covered with glass fiber reinforced plactic. Darrieus rotor research by Alcoa is reviewed.

13468 (NASA-CP—2106, pp 205-210) **Operational experience with VAWT blades At Sandia Laboratories.** Sullivan, W.N. (Sandia Labs., Albuquerque, NM). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

Sandia Laboratories has operated three Darrieus turbines (2 meter, 5 meter, and 17 meter diameter rotors) at its test facility for the last several years. Through this test program, a variety of blade types and rotor configurations have been tested for structural and aerodynamic performance. Blade structural performance aspects of the tests on the 17 meter rotor are discussed.

13469 (NASA-CP—2106, pp 211-224) **Structural analysis considerations for wind turbine blades.** Spera, D.A. (Lewis Research Center, Cleveland, OH). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

Items which should be considered in the structural analysis of a proposed blade design are briefly reviewed. These items include the specifications, materials data, and the analysis of vibrations, loads, stresses, and failure modes. The review is limited to the general nature of the approaches used and results achieved.

13470 (NASA-CP—2106, pp 225-238) **Blade design and operating experience on the Mod-0A 200 KW wind turbine at Clayton, New Mexico.** Linscott, B.S.; Shaltens, R.K. (Lewis Research Center, Cleveland, OH). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

A 200 KW wind turbine called Mod-0A is located in Clayton, New Mexico. The Mod-0A wind turbine blade is a 60 foot long aluminum structure, similar in appearance to an airplane wing, that weighs 2360 lbs. The blades, SN-1004 and SN-1005, accumulated over 3000 hours of operating time between November 1977 and April 1979. Signs of blade structural damage were first observed after 400 hours of wind turbine operation. The blades were removed from the wind turbine for repairs in June 1978. Repairs were completed and the blades were installed on the wind turbine for renewed operation in September 1978. Details of the blade design, loads, cost, structural damage and the blade repair are discussed.

13471 (NASA-CP—2106, pp 239-265) **Evaluation of an operating Mod-0A 200 kW wind turbine blade.** Donham, R.E. (Lockheed Aircraft Service Co., Ontario, CA). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The Mod-0A wind turbine blades, manufactured by Lockheed Aircraft Serivce Company (LAS), Ontario, California, are now operating in Clayton, New Mexico. These blades, rotated for the first time on November 30, 1077, establish the Mod-0A as the first wind-driven generator in 35 years to be continually tied into an electrical power system that services a community. Two additional sets of Mod-0A blades have become operational on the Island of Culebra, Puerto Rico, and Block Island, Rhode Island. Blade design follows that of the Mod-0 wind turbine built for NASA. The Mod-0A wind turbine blades are geometrically the same as the Mod-0 blades. Structural modifications recommended by Lockheed to extend the fatigue life of the Mod-0 blades and NASA's experience with the Mod-0 unit influenced the design of the Mod-0A turbine blade structure; so did cost and schedule constraints.

13472 (NASA-CP—2106, pp 267-284) **Design, fabrication, and test of a steel spar wind turbine blade.** Sullivan, T.L.; Sirocky, Jr.; Viterna, L.A. (Lewis Research Center, Cleveland, OH). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

One potential means for reducing the costs of wind turbine blades is to use a mass produced structure as the primary structural member of the blade. Tapered beams such as those used for utility poles are the type of mass produced structure envisaged. The airfoil shape could be formed by light-weight foam or light-weight ribs overwrapped with fiberglass cloth. In order to determine the feasibility of this concept, a 60 ft. steel spar blade was designed. Using this design, two blades were fabricated at the Lewis Research Center and tested on the Mod-0 wind turbine. The design and fabrication of the blades are described. Performance and blade load information is given and compared to analytical prediction. In addition, performance is compared to that of the original Mod-0 aluminum blades. Costs for building the two blades is given, and a projection is made for the cost in mass production. Finally, design improvements to reduce weight and improve fatigue life are suggested.

13473 (NASA-CP—2106, pp 285-292) **WTG Energy Systems' rotor: steel at 80 feet.** Barrows, R.E. (WTG Energy Systems, Inc., Buffalo, NY). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The 80 foot diameter rotor described has been installed and operational on WTG Energy Systems' MP1-200 wind turbine generator system since the summer of 1977. The MP1-200 wind turbine is installed as part of the Island of Cuttyhunk's electric power utility grid system. Cuttyhunk Island is located approximately 14 miles off the coast of southern Massachusetts. The MP1-200 wind turbine was developed, fabricated and installed by WTG Energy Systems as a production prototype. The MP1-200 is a synchronous generating system rated at 200 kilowatts at 28 mph wind velocity. Constant 60Hz, 480VAC current is produced directly from the wind turbine's generator at +/- 1% accuracy throughout the machine's operating range. A micro-processor based control system utilizing electrical load modulation is utilized to maintain constant rotor speed.

13474 (NASA-CP—2106, pp 298-308) **Use of wood for wind turbine blade construction.** Gougeon, M.; Zuteck, M. (Gougeon Brothers, Inc., Bay City, MI). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

In order to investigate the feasibility of a wooden wind turbine blade, NASA/DOE awarded a small contract to the Gougeon Brothers, Inc., in November of 1977. Several construction concepts were considered and evaluated. A monocoque D section forming the leading edge, and a built-up traling edge section was the selected method of construction. The required thickness to achieve the necessary structural properties in the D was examined for both a laminated veneer and bonded sawn stoch fabrication technique. Both of these techniques were ultimately judged to be feasible, with the comparative fabrication advantages determined by blade size and special epoxy and wood stock handling techniques, rather than by the resultant physical properties of the finished nose. In attempting to achieve a practical tail construction with a center of gravity for the blade at the quarter chord point, a number of tail panel construction techniques were considered. These included: (1) simple ply supported by stringers; (2) fiberglass/foam/fiberglass; (3) plywood/honeycomb/plywood; (4) plywood/honeycomb/plywood with aft web and slotting to relieve tail buckling. The final results of detailed strength and stiffness calculations for the last tail panel configuration showed that it was indeed feasible to use wood to meet the Mod 0A blade structural requirements. This work is presented in detail in the final report for NASA contract No. DEN3-9. A summary of the basic blade parameters is given.

13475 (NASA-CP—2106, pp 309-324) **Large, low cost composite wind turbine blades.** Gewehr, H.W. (Kaman Aerospace Corp., Bloomfield, CT). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

Various studies have shown that the cost of energy decreases with increasing rotor size in wind turbine generator systems, and that the cost of the rotor is a major contributon to initial procurement and annual operating costs. In an effort to reduce rotor cost, NASA Lewis Research Center, with Department of Energy funding, initiated a program to develop a large, low cost wind turbine blade representative of a design for a 300 ft-diameter wind generator system. The design, analysis, and test results of that program are presented. Fabrication of two composite blades for the Mod-1 200 ft-diameter wind turbine is described. Structural Composites Industries, Inc., Azusa, California, fabricated the spar for the 150 ft blade.

13476 (NASA-CP—2106, pp 325-342) **Mod-1 steel blade.** Van Bronkhorst, J. (Boeing Engineering and Construction Co., Seattle, WA). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

Since September of 1977, design, development, fabrication, testing and transport of two 100 foot metal blades for the Mod-1 WTS has been completed. Because the metal blade design was started late in the Mod-1 system development, many of the design requirements (allocations) were restrictive for the metal blade concept, particularly the maximum weight requirement. The unique design solutions required to achieve the weight goal resulted in a labor intensive (expensive) fabrication, particularly for a quality of only two blades manufactured using minimal tooling. Nevertheless, the very existence of the blades represents a major achievement in large wind turbine system development.

13477 (NASA-CP—2106, pp 343-354) **Boeing Mod-2 wind turbine system rotor.** Davison, G.N. (Boeing Engineering and Construction Co., Seattle, WA). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

The design details, significance of fatigue strength, design development test results, and conclusions of the preliminary design efforts for the Mod-2 rotor are presented.

13478 (NASA-CP—2106, pp 355-362) **Status of the Southern California Edison Company 3 MW Wind Turbine Generator (WTG) demonstration project.** Scheffler, R.L. (Southern California Edison Co., Rosemead). 1979.

From Conference on large wind turbine characteristics and R and D requirements; Cleveland, OH, USA (24 Apr 1979).

To demonstrate the concept of utility scale electricity production from a high wind energy resource, Southern California Edison Company (SCE) has initiated a program to construct and test a 3 megawatt (3000 kW) Schachle Wind Turbine Generator (WTG) at a SCE-owned site near Palm Springs, California. The background and current status of this program are presented along with a summary of future planned program activities.

13479 (ORO—5135-77/1) **Innovative wind turbines. Circulation controlled vertical axis wind turbine. Progress report, March 1-December 31, 1976.** Walters, R.E.; Fanucci, J.B.; Hill, P.W.; Migliore, P.G.; Squire, W.; Waltz, T.L. (West Virginia Univ., Morgantown (USA). Dept. of Aerospace Engineering). Oct 1978. Contract EY-76-C-05-5135. 140p. Dep. NTIS, PC A07/MF A01.

Theoretical and experimental research efforts in evaluating an innovative concept for vertical axis wind turbines (VAWT) are described. The concept is that of using straight blades composed of circulation controlled airfoil sections. The theoretical analysis has been developed to determine the unsteady lift and moment characteristics of multiple-blade cross-flow wind turbines. To determine the drag data needed as input to the theoretical analysis, an outdoor test model VAWT has been constructed; design details, instrumentation, and calibration results are reported. Initial testing is with fixed pitch blades having cross-sections of conventional symmetrical airfoils. Costs of building the test model are included, as well as estimates for blades constructed with composite materials. These costs are compared with those of other types of wind turbines.

13480 (RFP—2920/3533/78/6-1) **First semiannual report: Rocky Flats Small Wind Systems Test Center activities. Volume I. Description of the National Small Wind Systems Test Center.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 28 Sep 1978. Contract EY-76-C-04-3533. 111p. Dep. NTIS, PC A06/MF A01.

Information is presented concerning the Rocky Flats wind turbine test site; the philosophy of testing at Rocky Flats; test procedure development; atmospheric SWECS testing; SWECS component testing; data collection, handling, and analysis; reporting procedures; and future plans.

13481 (RFP—2920/3533/78/6-2) **First semiannual report: Rocky Flats Small Wind Systems Test Center activities. Volume II. Experimental data collected from small wind energy conversion systems.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 28 Sep 1978. Contract EY-76-C-04-3533. 109p. Dep. NTIS, PC A06/MF A01.

Volume II of the First Semiannual Report of the Rocky Flats Small Wind Systems Test Center (WSTC) describes the nine (9) small wind energy conversion systems (SWECS) tested as of June 30, 1978 and provides the significant quantitative and qualitative data collected to that date. Meteorological data collected at Rocky Flats are also provided and described.

13482 (WASH—2330-78/4(Vol.2)) **Design study and economic assessment of multi-unit offshore wind energy conversion systems application. Volume II. Apparatus designs and costs. Final report.** Kilar, L.A. (Westinghouse Electric Corp., East Pittsburgh, PA (USA)). 14 Jun 1979. Contract EX-76-C-01-2330. 310p. Dep. NTIS, PC A14/MF A01.

Parametric designs and companion cost functions are presented for each major component of an offshore wind energy conversion system (OWECS). These are (1) the support platforms, (2) the wind turbine generator (WTG) plants, and (3) the electrical energy collection and transmission system including (4) substations. A backup hydrogen energy delivery system for extremely remote or deep water sites was also evaluated. Costs are presented for fabricating, transporting, installing, operating, and maintaining each of these components.

13483 (WASH—2330-78/4(Vol.3)) **Design study and economic assessment of multi-unit offshore wind energy conversion systems application. Volume III. System analysis. Final report.** Kilar, L.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). 14 Jun 1979. Contract EX-76-C-01-2330. 192p. Dep. NTIS, PC A09/MF A01.

Optimum offshore wind energy conversion systems are described. The cost and performance of these systems are developed for a variety of conditions and the tradeoff between cost and energy production is made for the wide range of scenarios considered. The impact of the many design parameters on the major subsystems are briefly reviewed and the interactions which exist between subsystems are discussed. In particular, a section is devoted to dynamic interactions which might exist between the wind turbine generator (WTG) plant and the platform.

13484 **Cretan windmills.** Kanaki, M.T.; Probert, S.D. (Cranfield Inst of Technol, Bedfordshire, Engl). *Appl. Energy;* **5**: No. 3, 215-222(Jul 1979).

A resurgence of interest in this type of windmill has occurred recently because of its design simplicity and low cost. With it a relatively high rate of energy extraction may be achieved from low-speed winds.

13485 (COO—2616-2(Pt.1)(Rev.1)) **Further investigations of diffuser augmented wind turbines. Part 1. Executive summary. Final report.** Foreman, K.M.; Gilbert, B.L. (Grumman Aerospace Corp., Bethpage, NY (USA). Research Dept.). Jul 1979. Contract EY-76-C-02-2616. 11p. Dep. NTIS, PC A02/MF A01.

A multiphased experimental program is described which involves wind tunnel test facilities, and models of several compact diffuser configurations. Screens to simulate a wind turbine, and a three-bladed, fixed-pitch turbine have been used with the diffuser models. A candidate baseline design is described, and some of the key technical and economic issues which can lead to future full scale implementation are discussed.

13486 (COO—2616-2(Pt.2)(Rev.2)) **Further investigations of diffuser augmented wind turbines. Part 2. Technical report. Final report.** Foreman, K.M.; Gilbert, B.L. (Grumman Aerospace Corp., Bethpage, NY (USA). Research Dept.). Jul 1979. Contract EY-76-C-02-2616. 64p. Dep. NTIS, PC A04/MF A01.

A multiphased investigation is described which involves three test facilities of several compact diffuser approaches. Screens, to simulate a wind turbine, and a three-bladed, fixed-pitch turbine have been with the diffuser models. A candidate baseline design is described and some of the key issues are discussed that can lead to future full scale implementation.

POWER CONVERSION SYSTEMS

13487 (DSE—2553-79/1) **Energy from humid air. Final report.** Oliver, T.K.; Groves, W.N.; Gruber, C.L.; Cheung, A. (South Dakota School of Mines and Technology, Rapid City (USA)). Feb 1979. Contract EX-76-C-01-2553. 99p. Dep. NTIS, PC A05/MF A01.

Results to date are presented for a research project which is in progress at the South Dakota School of Mines and Technology. The goal of the research is to find a cost-effective process to convert the energy in humid air into mechanical work, which will be used to drive an electrical generator. The research is being carried out by computer modeling. Results for a natural draft tower show that it is not a cost-effective way to get energy from humid air. Parametric studies are presented for expansion-compression cycles. With suitable conditions, including large amounts of cooling during compression, this cycle has an attractive net work output. To avoid using all the output power to overcome machine losses, it appears necessary to use a one-machine mechanization. The most promising uses vortex flow to achieve the necessary expansion and subsequent compression with cooling. Power output and costs have been estimated for a vortex plant located in Puerto Rico.

SITE CHARACTERISTICS

13488 (RLO—2438-77/2) **Wind characteristics over complex terrain: laboratory simulation and field measurements at Rakaia Gorge, New Zealand.** Meroney, R.N.; Bowen, A.J.; Lindley, D.; Pearse, J.R. (Environmental Technology Assessment, Inc., Oak Brook, IL (USA)). May 1978. Contract EY-77-S-06-2438. 243p. Dep. NTIS, PC A11/MF A01.

A survey program is described which utilizes laboratory simulation of the relevant wind characteristics in a meteorological wind tunnel. To evaluate the validity of laboratory simultation methods and provide a confidence measurement bound for laboratory data, a limited field measurement program was simultaneously conducted. In this study both terraced and contoured models of the Rakaia River Gorge region were prepared to an undistorted geometric scale of 1:5000. The contoured model was examined for three separate surface roughness conditions: a surface textured to represent typical paddock grass roughness only, the same surface with zero-porosity shelterbelts added, and the same surface with porous shelterbelts added.

13489 (WASH—2330-78/4(Vol.4)) **Design study and economic assessment of multi-unit offshore wind energy conversion systems application. Volume IV. Meteorological and oceanographic surveys. Final report.** Kilar, L.A. (Westinghouse Electric Corp., East Pittsburgh, PA (USA)). 14 Jun 1979. Contract EX-76-C-01-2330. 344p. Dep. NTIS, PC A15/MF A01.

The results are presented of a survey of the meteorology and oceanography of the United States offshore as they pertain to the design, cost, emplacement, operation and maintenance of offshore wind energy conversion systems (OWECS). This report is intended to define the environment in which OWECS are to be considered.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 13675

POWER PLANTS AND POWER GENERATION

13490 (EPRI-FP—1173) **Conceptual design of a Gulf Coast lignite-fired atmospheric fluidized-bed power plant. Final report.** Kimel, E.; Panico, S.; Armstrong, J.; Wysocki, J. (Burns and Roe, Inc., Woodbury, NY (USA)). Sep 1979. 246p. Dep. NTIS, PC A11/MF A01.

The report presents the design and economic comparisons of a nominal 530 MWe net atmospheric fluidized-bed combustion (AFBC) plant and comparable pulverized lignite-fired (PLF) plant with a limestone based flue gas desulfurization (FGD) system. Both plants are mine-mouth installations, located in Freestone County, Texas, and designed to burn Texas lignite, with a higher heating value of 6500 Btu/lb and a sulfur content of 1%.

13491 (EPRI-WS—78-134) **Plant performance testing and evaluation workshop. Workshop proceedings.** Bloom, N.; Burns, E.T. (eds.). (Science Applications, Inc., Palo Alto, CA (USA)). Nov 1979. 291p. Dep. NTIS, PC A13/MF A01.

Eighteen papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

13492 (EPRI-WS—78-134, pp 3.57-3.63) **Performance monitoring by controllable losses.** Davis, J.S. (Duke Power Co., Charlotte, NC). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The development and use of power plant performance monitoring techniques at the Duke Power Company are discussed. Information is included on unit and system heat rate monitoring, the effect of performance improvements on operating and fuel costs, and the control of losses in power plant components in order to achieve the optimum performance. (LCL)

13493 (EPRI-WS—78-134, pp 5.3-5.11) **Instrumentation used at PECO for dynamic testing.** O'Brien, J. (Philadelphia Electric Co., PA). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

A completely self-contained mobile test facility used by the Philadelphia Electric Company to perform dynamic power plant testing is described. Details on the measuring instruments used and the 50-channel data acquisition system are presented. (LCL)

13494 (EPRI-WS—78-134, pp 5.99-5.103) **Portable data acquisition system for steady state and transient response testing.** Berkowitz, D.A. (JAYCOR, Bedford, MA). Nov 1979

In Plant performance testing and evaluation workshop. Workshop proceedings.

The need for rapid sampling of power plant performance data on a common time base is discussed, and a high-speed minicomputer controlled data acquisition system is described, which was successfully employed at an experimental fluidized bed combustion facility.

13495 (EPRI-WS—78-134, pp 6.3-6.28) **Method for power plant performance evaluation.** Lang, F.D.; Kettenacker, W.C.; Yee, N.S.; Koester, G.E.; Warrant, R.W. (Energy Inc., Idaho Falls, ID). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

Efficient operation of steam power plants requires optimization of control parameters affecting both the heat source and turbine-generator cycles. This is best accomplished by integrated study of the plant heat rate (Btu/kW-hr) as affected by system hydraulic parameters, equipment hardware, cycle piping arrangement, turbine characteristics, feedwater heat, etc. The ability of a power engineer to adequately analyze steam cycles is dependent on rapid and cost-effective computational aids. PEPSE (Performance Evaluations of Power System Efficiencies) was developed for this purpose and is a general purpose computer code which simulates the entire power plant in steady state by modular construction of a plant's component hardware. The PEPSE user specifies unique turbine cycle piping and unit configuration layouts by simply interconnecting components (e.g., hardware items such as turbine stage groups or pumps) with streams (lengths of piping). PEPSE can be used for: performance optimization studies; determining the consequences on heat rate of component performance, i.e., sensitivity studies; design studies; and validation of manufacturers' claims for the performance of plant components. An introduction to the formulation of the computational techniques, the scope of PEPSE, the various governing equations associated with components and streams, and results of typical sensitivity studies are presented. (LCL)

13496 (EPRI-WS—78-134, pp 6.29-6.35) **Methods used for establishing plant performance.** Clelland, P.J. (Philadelphia Electric Co., PA). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The mathematical modeling of power plant performance by means of input/output (I/O) analyses for each generating unit is discussed. I/O curves relate unit output to the cost of generating that output and are used to reflect the current economics of a plant and to develop improved dispatch strategies, i.e., allocation of the system load among the various generating units. (LCL)

13497 (EPRI-WS—78-134, pp 6.37-6.43) **Performance calculations.** Rovnak, J. (Stone and Webster Engineering Corp., Boston, MA). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The purpose, scope, and significance of performance calculations for thermal power plants are discussed. It is concluded that with escalating fuel costs, the need for computer capabilities for predicting plant performance will gain increased importance. (LCL)

13498 (EPRI-WS—78-134, pp 6.45-6.51) **Plant modeling under steady state and transient conditions.** Harper, B.E. (Bechtel Corp., San Francisco, CA). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

Plant modeling studies have been conducted for many electric power plant projects for which Bechtel has engineering and/or construction responsibilities. Current modeling work, needs in the modeling area, and some thoughts on the new generic power plant performance modeling project that Electric Power Research Institute (EPRI) has just begun are discussed.

13499 (N—79-17347) **Signal averaging techniques applied to detection of partial discharges in electrical plant.** Wilson, A. (Central Electricity Generating Board, London (UK)). May 1978. 3p. NTIS, PC A02/MF A01.

Diagnostic testing of insulation in electrical plants was conducted. An attempt to detect the extent of partial breakdowns at incipient fault sites was made. High interference from sensitive measurements with the installed equipment was reported. The interference, discharges, signal averaging, discharge measurements, and associated instrumentation were examined.

13500 (N—79-26380) **Multichannel pressure sampling and storage system.** Hockings, K.J. (Central Electricity Generating Board, Bristol (UK)). Dec 1978. 8p. NTIS, PC A02/MF A01.

For multiple sampling of power station plant parameters such as pressure or flow, it is proposed to install one transducer for three or four sample points and then switch sequentially by means of a timer control (1) the input pressure signals to the transducer via a rotary switch valve, and (2) the resultant output electrical signals from the transducers to storage capacitors for subsequent reading by a data logging system.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 13487

13501 (COO—2381-1(3-79)) **Overview of the Chalk Point Cooling Tower Project, 1972-1979.** Moon, M.L. (ed.). (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Mar 1979. Contract EY-76-C-02-2381. 172p. Dep. NTIS, PC A08/MF A01.

The objectives, methodologies, data, and analytical results of the Chalk Point Cooling Tower Program are reviewed. The overview intergrates the concepts and activities of the various program elements to provide a coherent view of the program in its entirety. Samples of the various data acquired are included together with very brief summaries of the conclusions. The report is extensively referenced to provide specific directions to the more extensive treatments of the program, data tabulations, and tape libraries availa-

ble in the complete library of Chalk Point reports. The Chalk Point data is a resource for the study of cooling tower salt deposition processes and impacts in general. The methods used, while developed to facilitate the assessment of salt drift impact at Chalk Point, also have applicability to cooling tower impact analysis at other sites.

13502 (FE—2357-41) **PFB coal fired combined cycle development report. Design evaluation report.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Dec 1978. Contract EX-76-C-01-2357. 31p. Dep. NTIS, PC A03/MF A01.

The design review team addressed four major questions: the logic and structure of the design approach; the adequacy and completeness of the preliminary design as the basis for the next step definitive design of a pilot plant; the soundness of the performance projections; and the appropriateness of the risk assessment. The reviewers concluded that the approach is sound and the logic and structure reflect appropriate design disciplines for this stage of the project, the disciplines reflect General Electric practice for complex development projects, and comments by external reviewers suggest these disciplines are not standard in other companies; the preliminary design is a sound basis for the next step provided that the required technology tests confirm the design assumptions. (Most of the required tests are planned, but some areas require additional confirmation); and performance projections at steady-state full load are basically sound and require only minor refinements. Performance projections at part load and under transient conditions require additional effort to provide adequate definition, and no barrier problems are anticipated, but minor design changes could enhance plant load response characteristics. The review team basically agreed with the risk assessment of the design team on the reference plant approach, although this represents a consensus of a broad spectrum of individual opinions on many questions. The review team did point out several areas where additional parallel efforts might improve the design or lessen the risk involved in the reference approach.They specifically expressed concern that some promising technology developments were being discarded prematurely.

13503 (PB—292529) **A primer on the rejection of waste heat from power plants. Final report.** Mitchell, R.D.; Horsak, R.D. (Beck (R.W.) and Associates, Denver, CO (USA)). May 1978. 49p. NTIS, PC A03/MF A01.

The report explains the workings and importance of cooling systems in power plants. Many of the terms used in the energy industry are defined in the chapter reviewing the basic operation of power plants. The rest of the report focuses on the cost and efficiency of various waste heat rejection systems (cooling systems), such as once-through circulating systems, cooling ponds and lakes, spray ponds, and wet and dry cooling towers. The effects of cooling systems on the environment, and on the production and cost of electricity, are also considered.

POWER CYCLES

REFER ALSO TO CITATION(S) 13319, 13721, 14060

WASTE-FUELED SYSTEMS

REFER ALSO TO CITATION(S) 13227

13504 (COO—4709-T2) **Detroit Lakes Energy Systems Study: Phase I extension. Final report, August 1, 1978-January 15, 1979.** (Western Minnesota Municipal Power Agency, Detroit Lakes (USA)). 31 Jan 1979. Contract ET-78-G-02-4709. 100p. Dep. NTIS, PC A05/MF A01.

An assessment of the resource availability of biomass and the potential of utilization of renewable energy systems in Detroit Lakes, Minnesota is presented. The feasibility of retrofitting the existing power plant to house a biomass energy system is discussed. Survey and evaluation of current off-the-shelf farm implement equipment which can be adapted to the handling of selected biomass materials is presented. Density studies on sunflower stalks, grain straw, and forest residues are included. (DC)

COMPONENTS

REFER ALSO TO CITATION(S) 13034, 13502, 13521

13505 (DOE/ET/40291—1) **Demonstration of the Environmental Data Corporation Spectral Fuel Conservation System program plan.** (Environmental Data Corp., Monrovia, CA (USA)). 15 Nov 1979. Contract AC02-79CS40291. 42p. Dep. NTIS, PC A03/MF A01.

The purpose of this program is to demonstrate and quantify the amount of fuel that can be saved if the Spectral Fuel Conservation System (SFCS) developed by the Environmental Data Corporation (EDC) is installed in coal-fired industrial boilers. Of central importance to the program are the selection of an appropriate test site and the preparation and methodical application of a comprehensive test strategy. Consequently, the sections dealing with these topics in the proposal have been considerably expanded in this program plan to include as much preparatory thinking as is possible at this early stage. The remainder of this document is essentially an update version of the technical portion of the proposal. No change in the schedule is anticipated.

13506 (DOE/ET/40291—2) **Demonstration of the Environmental Data Corporation Spectral Fuel Conservation System. Quarterly report, October-December, 1979.** (Environmental Data Corp., Monrovia, CA (USA)). 18 Jan 1980. Contract AC02-79CS40291. 12p. Dep. NTIS, PC A03/MF A01.

A program plan was prepared and submitted to the Department of Energy in November 1979. The criteria that must be satisfied by the host site for a successful demonstration of the Spectral Fuel Conservation System have been developed and are included in this report. The process of demonstration site selection is underway and is expected to be completed on schedule by March 31, 1980. Preliminary discussions with Union Carbide indicate that the coal-fired boilers at the company's specialty chemicals plant in Institute, West Virginia appear to satisfy all the major site criteria. Exchanges of drawings are now in progress for further evaluation prior to undertaking a site inspection visit. Finally, a literature search has been initiated to determine the distribution by size and type of coal-fired boilers in the industrial sector as background to the energy savings analysis required in Task 11.

13507 (EPRI-WS—78-134, pp 3.3-3.50) **Thermal performance testing and modeling of CEGB boilers.** Lawn, C. (Central Electricity Generating Board, Marchwood, UK). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The development in the United Kingdom of computer models of boilers for fossil-fuel power plants so that the thermal efficiency, flexibility, and availability of these plants can be optimized is discussed, and examples are presented of the use of these models for predicting the performance of specific boilers. (LCL)

13508 (EPRI-WS—78-134, pp 3.51-3.56) **ASME performance test codes and their relationship to plant testing and thermal performance analysis.** Scharp, C.B. (Baltimore Gas and Electric Co., MD). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The ASME performance test codes and standards for power plant equipment, the procedures used to develop these codes, and some of the considerations that influence code methodology are discussed.

13509 (EPRI-WS—78-134, pp 4.3-4.20) **Boiler testing and performance analysis.** Durrant, O.W. (Babcock and Wilcox, Barberton, OH). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The mathematical modeling of coal-fired power plant components and systems in order to determine the interactions between these components, methods for applying control systems, and ways to optimize performance while minimizing operating problems is discussed. Problems associated with boiler testing are reviewed. Recommendations are made for planning, instrumenting, and conducting boiler performance tests. (LCL)

13510 (EPRI-WS—78-134, pp 4.21-4.24) **Experiences in recent ASME turbine acceptance test.** Luksan, D.L. (Consumers Power Co., Jackson, MI). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The experience of one company in planning and conducting heat rate tests on a turbine for a 635 MW oil-fired power plant is described. (LCL)

13511 (EPRI-WS—78-134, pp 4.25-4.28) **Analytical solution techniques.** Babb, J.A. (Consumers Power Co., Jackson, MI). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

A description is given of how acceptance test data are presently analyzed at Consumers Power Company. As performance engineers assigned the task of reviewing the vendor's work on a recent acceptance test, computer programs were developed to duplicate all acceptance test calculations. The purpose was to insure accuracy of the information reported by the vendor and to educate Consumers Power Company personnel in this area so as to have the in-house capability of performing the analysis for any turbine heat rate testing no matter the level of sophistication.

13512 (EPRI-WS—78-134, pp 4.29-4.42) **Performance improvement at New Boston.** Berkowitz, D.A. (JAYCOR, Bedford, MA). Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

In order to design an improved fuel controller for an operating, 386 MW(e), oil-fired power plant, a mathematical model of the plant was developed from fundamental principles to predict thermal-hydraulic transients. The controller was successfully implemented in the actual plant by replacing a portion of the original control system. The resulting minimum operating level of the system was thus reduced from 220 MW(e) to flash tank level of 130 MW(e), and the customary load rate of change during normal operation improved from approximately 2 MW/min to 9 MW/min.

13513 (EPRI-WS—78-134, pp 5.13-5.33) **Computer controlled data acquisition system for field performance tests.** Southall, L.R.; Wilson, R.H.; Carrick, F.S. Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The design and operation of a trailer-contained mobile data acquisition system for the performance testing of thermal power plant steam turbines are discussed. It is concluded that the computerized data acquisition system, coupled with real-time test analysis programming, is providing test engineers with increased data visibility and better test manageability, and improves the quality of field testing. (LCL)

13514 (EPRI-WS—78-134, pp 5.65-5.81) **Air/gas path testing for furnace implosion studies.** Kirchmeier, W.E. Jr. Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

Furnace implosions continue to be a problem in the electric utility industry as a whole due to the complex phenomena of this entire process. An investigation on all the pertinent areas contributing to this problem is reported. The information presented was gathered from field testing, client studies and in-house research programs. The types of tests and their results which are necessary to support a complete, accurate computer model study of the air-boiler-gas path and the draft control system are presented. It is recommended that, when field testing any boiler, do not trip the unit from a higher load than the unit has been tripped from before. Also, leave the draft control system and its attendant safety circuitry operational (i.e., in automatic). When doing a computer model study be careful to scale things properly and use the correct flame decay time, especially if a draft control system study is performed. The decisions made as a result of the model study can be very expensive to implement and could turn out to be tragic if errors are made. (LCL)

13515 (EPRI-WS—78-134, pp 5.83-5.98) **Draft control system design, simulation and test for a high implosion potential boiler.** Vollmer, H.D.; Undrill, J.M.; Crim, H.G. Jr. Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

The actions taken by Potomac Electric Power Company upon realization that their Chalk Point Unit 3 had a very high potential for boiler implosion are described. The combination of a high draft loss boiler design, 76"H2O I.D. fan head, pneumatic controls, vendor warnings, and industry problems led PEPCo to the above realization. Corrective actions involved major control revisions including electronic draft control, computer simulation of system by consultant, very detailed system checkout, very detailed static and dynamic test procedure development, coordinated testing and model simulation, with model calibration prior to each of successively higher load trip test, culminating in full 630-MW intentional boiler trip and ultimately with a high load trip with loss of control power.

13516 (PB—292536) **Theoretical study of the earthquake response of a coal handling elevator support struture.** Yang, T.Y.; Morehead, R.C.; Bogdanoff, J.L. (Purdue Univ., Lafayette, IN (USA). School of Aeronautics and Astronautics). 30 Apr 1978. 164p. NTIS, PC A08/MF A01.

This report is concerned with determining the seismic response of a supporting structure for two handling elevators at a TVA steam power generating plant in Paradise, Kentucky. It describes the dynamic behavior of the system, modeling, frequencies and mode shapes, a 3-dimensional plotting program, a response spectrum analysis, an earthquake time-history response analysis, and discusses results based on two types of graphical presentation. The 3-dimensional plotting program has the capabilities of displaying either the basic structural model or of superimposing a deformed structural configuration, such as mode shape, upon the original undeformed configuration. Illustrations include descriptions of a general 3-dimensional beam finite element and a general quadrilateral plate finite element in a 3-dimensional space, a basic structural model, vibrational modes, yield and buckling ratios, Z-displacement time-histories, axial stress time-histories, and bending moment time-histories.

13517 (PB—292553) **Dynamic response of high pressure steam pipe in a fossil fuel power plant.** Sun, C.T.; Lo, H.; Bogdanoff, J.L.; Chou, Y.F. (Purdue Univ., Lafayette, IN (USA). School of Aeronautics and Astronautics). Apr 1978. 54p. NTIS, PC A04/MF A01.

Piping systems in power plants are usually flexibly supported to allow thermal expansion. As a result, natural frequencies of the lower modes are low, and the systems are susceptible to damage due to dynamic disturbances such as earthquakes. The dynamic behavior of a high pressure steam pipe in the fossil fuel power plant of Unit No. 3 of the Tennessee Valley Authority at Paradise, Kentucky is investigated. This piping system connects the header at the top of the steam generator to the turbine at the ground level. The pipe is assumed fixed at the ground level and either fixed or attached to a shear beam model that represents the frame structure of the power plant. Free vibrations are first studied. Dynamic responses of the system subjected to the NS component of the ground acceleration in the El Centro 1940 earthquake record are obtained. The effects of damping, the material stiffness, and the frame structure on the piping responses are investigated.

13518 **Characteristic frequencies and mode shapes for turbogenerator shaft torsional vibrations.** Triezenberg, D.M. pp 6p, Paper F 79 755-0 of 1979 IEEE summer power meeting. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From 1979 IEEE summer power meeting; Vancouver, Canada (Jul 1979).

Fundamental to the study of turbogenerator shaft torsional vibrations occurring in subsynchronous resonance and high speed reclosing is the calculation of the characteristic frequencies and associated mode shapes of the vibrations. A calculation procedure is discussed which is based on distributed system concepts and does not require matrix eigenvalue-eigenvector routines as does the conventional method based on lumped inertia and compliance. The procedure is of value in the analysis and simulation of torsional vibrations. 10 refs.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 13814, 13815

13519 (PB—292343) **Responses of several forage and field crops to subsurface soil warming and sewage effluent spray irrigation. Master's thesis.** Mellish, G.A. (Pennsylvania State Univ., University Park (USA). Dept. of Agronomy). Aug 1978. Contract DI-14-31-0001-5222. 169p. NTIS, PC A08/MF A01.

The influence of soil warming and sewage waste water irrigation on winter survival, maturation, yield, quality, and pest relationships of various crops was evaluated. An electric power plant-soil warming system was simulated by circulating hot water from an oil-fired boiler through a pipe network buried at a 30-cm depth and 60-cm spacing. Treatments consisted of soil temperature regimes which were approximately 13 and 9C above average annual ambient soil temperatures at the 15-cm depth and an ambient soil control. Treatment areas were spray-irrigated with treated sewage waste water twice weekly. Four cropping systems were used. Soil warming delayed the development of autumn cold tolerance in alfalfa, winter wheat, and winter barley and reduced cold tolerance attained by the winter cereal crops. Soil warming stimulated early spring growth and increased the rate of maturation of most crops. Yield responses to soil warming varied with the type of crop. Annual and perennial crops could be grown on heated and waste water irrigated soil in the Northeast and double cropping would be more feasible than with a conventional agricultural system.

ECONOMICS

13520 (PB—294826) **Generic environmental impact statement of electric utility tariffs(Wisconsin).** (Wisconsin Public Service Commission, Madison (USA)). 1 Jun 1977. 313p. NTIS PC A14/MF A01.

Section I of the report describes the framework of ratemaking decisions--regulatory law, determination of revenues allowed to accrue to the utility, trends in energy demand and supply, rate designs and utility financing. Section II presents results of the impact analysis. Several rate designs were applied to customers of a Wisconsin utility, Wisconsin Electric Power Company, for a 1975 test year. The resulting customer bill and usage impacts are presented and discussed, assuming no change in usage and alternatively elasticity values derived from published studies. Preliminary results of a PSC study on the relationship between household energy consumption and household income are presented. A method for assessing physical impacts of rate designs is discussed and demonstrated. Alternative responses to the rising cost of electricity are the subject of Section III. The greatest attention is given to the desirability and feasibility of implementing load control and interruptible rates. Eight appendices and a glossary are also included.

OFF-PEAK ENERGY STORAGE

REFER ALSO TO CITATION(S) 13715

FUELS

REFER ALSO TO CITATION(S) 12917, 13020, 13219

13521 Expanding the regulation range of pulverized coal 200 MW power units. Larionov, V.F.; Avdeev, I.A.; Magadeev, V.Sh. *Sov. Power Eng. (Engl. Transl.);* 7: No. 5, 265-268(May 1978).

Translated from Elektr. Stn.; 7: No. 5, 17-19(May 1978).

Under conditions of irregularity of the power system daily load graph, one of the most difficult problems is system unloading in the hours of the night load drop. At the present time the furnaces of boiler units designed to burn pulverized fuel use liquid fuel for supplementary burning during unloading. Thus, it is interesting to determine the regulation range of pulverized fuel power units during burning of solid fuel with full transfer to oil. The present study examines methods of expanding the regulation range of a 200 MW power unit with an YeP-140/640 zh boiler unit during separate and combined combustion of anthracite fine and oil. The studies include establishment of the technical minimum load, reliability and economy of operation and the corrosiveness of the exhaust gases in the 50 to 200 MW power unit load range.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 12993, 13523, 14155, 14392, 14395, 14396, 14397, 14399, 14418, 14426

13522 (PB—290459) **Hazards in non-nuclear power plants. Final report.** Roman, W.S.; Israel, W.J.; Sacramo, R.F. (NUS Corp., Rockville, MD (USA)). Jul 1978. 234p. NTIS, PC A11/MF A01.

The report describes and ranks the health and safety hazards to the general public of coal-fired, oil-fired steam turbine, combined cycle, combustion (gas) turbine, and geothermal power plants. Occupational hazards are not considered. Hazardous events and conditions for normal and abnormal plant operations are identified and classified. Each of the ninety hazards identified are rated in six categories: (1) area/population exposed; (2) duration of exposure; (3) mitigating factors; (4) quantity/toxicity ratio; (5) the nature of the effects on health; and (6) public attitude. Weighting factors are applied to each criterion. The overall rating of a hazard is given as a total of the six weighted criteria. Highest hazard ratings for normal plant conditions are given to air pollutants from the combustion cycle and to hydrogen sulfide emissions from geothermal plants; low ratings went to water pollution, cooling tower effects and ncise. Abnormal plant occurrences such as fires and chlorine releases received relatively low scores in the overall risk assessment. This report only begins a comprehensive evaluation of the hazards on non-nuclear power plants. Studies of the hazards involved in fuel transportation, power transmission, and additional power generation technologies are recommended.

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 13501

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 12991, 12994, 12995, 12996, 12997, 12998, 12999, 13000, 13036, 14217, 14391

13523 (BNL—27164) **Environmental control technology for atmospheric carbon dioxide.** Steinberg, M.; Albanese, A.S. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 31p. (CONF-800309—1). Dep. NTIS, PC A03/MF A01.

From International workshop on the energy/climate interactions; Munster, F.R. Germany (3 Mar 1980).

The impact of fossil fuel use in the United States on worldwide CO_2 emissions and the impact of increased coal utilization on CO_2 emission rates are assessed. The aspects of CO_2 control are discussed as well as the available CO_2 control points (CO_2 removal sites). Two control scenarios are evaluated, one based on the absorption of CO_2 contained in power plant flue gas by seawater; the other, based on absorption of CO_2 by MEA (Mono Ethanol Amine). Captured CO_2 is injected into the deep ocean in both cases. The analyses indicate that capture and disposal by seawater is energetically not feasible, whereas capture and disposal using MEA is a possibility. However, the economic penalities of CO_2 control are significant. The use of non-fossil energy sources, such as hydroelectric, nuclear or solar energy is considered as an alternative for limiting and controlling CO_2 emissions resulting from fossil energy usage.

13524 (CONF-800115—1) **Methods for analysis of trace organic constituents on fly ash.** Griest, W.H.; Caton, J.E.; Yeatts, L.B. Jr.; Maskarinec, M.P. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 24p. Dep. NTIS, PC A02/MF A01.

From 2. conference on air quality management in the electric power industry; Austin, TX, USA (22 Jan 1980).

Currently, ultrasonic solvent extraction is one of the better methods for obtaining an organic extract of fly ash, although some strongly sorbed polycyclic aromatic hydrocarbons (PAHs) may be poorly extracted. The solvent extracts of fly ash can be analyzed directly by gas chromatography (GC) for volatile constituents. In stack and electrostatic precipitator hopper ash (ESP ash) samples, the volatiles consist for the most part of C_{15} through at least C_{36} n-paraffins and other hydrocarbons. Concentrations range from a few ppB to nearly 1 ppM. Concentrations and complexity of the profiles vary considerably from source to source of ash. Preliminary studies suggest, however, that the bulk of the extractable mass is not amenable to direct GC analysis. Specific chemical classes can be isolated from the solvent extracts. PAHs are isolated by adsorption column chromatography and determined by procedures optimized for the fly ash sample size or expected PAH concentration levels. PAHs isolated from small ($\sim$ 3 g) samples of ash are determined with great sensitivity and specificity by the thin-layer chromatography procedure with in-situ fluorescence measurement, while the PAHs isolated from larger samples may be analyzed in greater detail by capillary column GC. The parent, unsubstituted PAHs appear to predominate in PAHs isolated from ESP ash with concentrations ranging from 0.03 to 30 ppB. Again, concentrations vary considerably depending on ash source. 3 figures, 4 tables.

13525 (FE—3199-T2) **Electron beam ionization for coal fly ash precipitators. Annual report, July 14, 1978-July 13, 1979.** Davis, R.H. (Florida State Univ., Tallahassee (USA)). Sep 1979. Contract ET-78-S-01-3199. 30p. Dep. NTIS, PC A03/MF A01.

The results of the work have met or exceeded the early expectations. Progress is discussed after an introduction in which the intended role of electron beam ionization of coal fly ash is reviewed. The measurements of ion current density have been eminently successful in that measured values were even larger than expected and no saturation was observed. In a tightly confined good geometry, saturation has been observed but the analysis of the results is not complete at this time. The construction and test of a bench precipitator system, is 3 or 4 months behind schedule because of the delay in recruiting a post-doctoral Research Associate. Several new ideas have come up and a further delay has been caused by the need to build a modular system which will incorporate or test some of the new ideas.

13526 (PB—292073) **Entropy (available energy) analysis, energy and environmental control applications. Technical report.** Schiff, D. (Mitre Corp., McLean, VA (USA). METREK Div.). 1978. 82p. NTIS, PC A05/MF A01.

The concept of available energy is shown to be a useful application of second law (entropy) analysis. Two types of second law analysis were chosen to represent two extremes in considering the relative merits of alternative energy and pollution control technologies. An analysis of a flue gas desulfurization system on an existing coal fire plant has shown that the bus-bar available energy for its pollution control scrubber is less than the bus-bar available energy for the scrubber modified with a heat recovery unit. Second law analysis is also applied to the available energy loss due to human health effects as represented by disability days and premature mortalities. An overall analysis of available energy and costs compares a present power plant operation including a flue gas desulfurization (FGD) system, a power plant without an FGD system, and a power plant with an FGD system and additional heat exchangers replacing the reheaters. The La Cygne power plant of Kansas City Power and Light was used as an example in the study.

13527 (PB—292327) **Design guidelines for an optimum scrubber system. Final report, April 1978—October 1978.** Kashdan, E.R.; Ranade, M.B. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jan 1979. Contract EPA-68-02-2612. 94p. NTIS, PC A05/MF A01.

The report gives results of a review of the performance and operating experience of existing utility scrubber systems and the state-of-the-art in design of scrubber components. It also gives guidelines for the design of the optimum wet scrubber system, based on this review. The U.S. EPA's Industrial Environmental Research Laboratory, Research Triangle Park, North Carolina, is considering a demonstration of an optimum wet scrubber system for use on a coal-fired utility boiler. The optimum wet scrubber system has such design goals as maximum particulate collection, low power consumption, and low maintenance.

13528 (PB—292385) **Epa industrial boiler FGD survey: fourth quarter 1978. Final report, October—December 1978.** Tuttle, J.; Patkar, A.; Welch, D.; Hessling, M.; Eckstein, M. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Feb 1979. Contract EPA-68-02-2603. 233p. NTIS, PC A11/MF A01.

The report gives detailed technical information concerning application of flue gas desulfurization (FGD) systems to industrial boilers. Design and operation data is presented for 172 FGD control systems (132 of them operational), designed to control SO^2 emissions from 206 industrial boilers at 61 plants. With a 1978 capacity of 9.2 million scfm, an average of more than seven new FGD systems have been put on line each year since 1972. Information in the report was obtained by a survey of plant personnel, control system vendors, regulatory agencies, and consulting engineering firms. The data is given in two types of tables: one gives summary information; the other, detailed information. Summary tables present information as a function of control process, control system vendor, disposal technique, operational status, startup date, and flue gas capacity. Detailed information includes: control system design, economics, operating experience, problems and solutions, waste disposal techniques, and maintenance practices.

13529 (PB—297947) **Technical assessment of thermal DeNOx Process. Final report Nov 77—Dec 78.** Castaldini, C.; Salvesen, K.G.; Mason, H.B. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). May 1979. Contract EPA-68-02-2611. 138p. NTIS, PC A07/MF A01.

The report gives results of a technical/economic assessment of Exxon's Thermal DeNOx Process, applied to coal-fired utility boilers. The assessment was performed in parallel with a study in which the performance/cost of the process was estimated for eight coal-fired utility boilers representative of the Nation's boiler population. The report concludes that the process is a promising technique for controlling NOx emissions from utility steam generators. However, a number of limitations need to be evaluated when the process is retrofitted to coal-fired boilers. Flue gas temperature fluctuations (caused primarily by load following, furnace slag deposition, and tube fouling) may limit NOx reductions to approximately 50%. In addition, operational and environmental impacts of NH3 emissions and ammonium bisulfate formation could further limit the performance of the process and affect its applicability. These limitations are best evaluated on full scale. Total operating costs are estimated between 0.27 and 1.23 mills/kWhr, exclusive of license fee. Actual costs depend primarily on boiler size, initial NOx concentration, and level of control required. The assessment also considered the impact of widespread process implementation on the ammonia market, feedstock supplies, and their costs. The impacts were found to be small.

SITE SELECTION AND LAND USE

REFER ALSO TO CITATION(S) 14233

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 13312, 13314, 14253, 14388

13530 (CONF-790904—P2) **Systems engineering for power: organizational forms for large scale systems. Volume I.** Fink, L.H.; Trygar, T.A. (eds.). (Department of Energy, Washington, DC (USA)). Oct 1979. 376p. Dep. NTIS, PC A17/MF A01.

From Systems engineering for power: emergency operating state control conference; Davos, Switzerland (30 Sep 1979).

Separate abstracts have been prepared for each individual section. (TFD)

13531 (CONF-790904—P2, pp 92p, Section I) **Development of decentralized organizational forms for large scale interconnected power systems.** Sandell, N.R. Jr.; Castanon, D.A.; Laub, A.J. (Massachusetts Inst. of Tech., Cambridge). Oct 1979.

From Systems engineering for power: emergency operating state control conference; Davos, Switzerland (30 Sep 1979).

The document is the final report of a three year research project sponsored by the Division of Electric Energy Systems of the Department of Energy. The broad objective of the research project was to devise means for obtaining decentralized control structures for large scale systems, with the theoretical developments being of potential applicability to interconnected power systems. A number of strategies were investigated for obtaining the desired control structures. These were the approximation of centralized control laws; the development of controllers using multiple, approximate models of the overall system; the use of decomposition methods; and a direct formulation of decentralized optimal stochastic control problems. Project highlights include: (1) development of a new algorithm for solution of large scale (e.g., 100 state) linear-quadratic-Gaussian optimal control problems; (2) development of a test for the applicability of singular perturbation approximations using function space ideas; (3) development of a unified formulation and local convergence analysis for decomposition methods; and (4) development of optimality conditions for control of linear stochastic system with linear, but not necessarily finite-dimensional, decentralized controllers.

13532 (CONF-790904—P2, pp 96p, Section II) **Perturbation methods in construction of model decompositions for large-scale system analysis.** Kwatny, H.G.; Bahar, L.Y.; Massimo, F.M.; Spare, J.H. (Drexel Univ., Philadelphia, PA). Oct 1979.

From Systems engineering for power: emergency operating state control conference; Davos, Switzerland (30 Sep 1979).

The objectives of this research are to develop a methodology for the application of the method of averaging to large systems analysis and to evaluate the effectiveness of averaging methods in dealing with problems which inherently require some means of reduction and decomposition in order that formal analysis be practicable. This research applies averaging concepts to the development of a procedure for model decomposition and aggregation such that the resultant simplified models retain a meaningful physical structure.

13533 (CONF-790904—P2, pp 70p, Section III) **Descriptor variable approach to modeling and optimization of large-scale systems.** Stengel, D.N.; Luenberger, D.G.; Larson, R.E.; Cline, T.B. (Systems Control, Inc., Palo Alto, CA). Oct 1979.

From Systems engineering for power: emergency operating state control conference; Davos, Switzerland (30 Sep 1979).

A new approach to modeling and analysis of systems is presented that exploits the underlying structure of the system. The development of the approach focuses on a new modeling form, called descriptor variable systems, that was first introduced in this research. Key concepts concerning the classification and solution of descriptor variable systems are identified, and theories are presented for the linear case, the time-invariant linear case, and the nonlinear case. Several standard systems notions are demonstrated to have interesting interpretations when analyzed via descriptor variable theory. The approach developed also focuses on the optimization of large-scale systems. Descriptor variable models are convenient representations of subsystems in an interconnected network, and optimization of these models via dynamic programming is described. A general procedure for the optimization of large-scale systems, called spatial dynamic programming, is presented where the optimization is spatially decomposed in the way standard dynamic programming temporally decomposes the optimization of dynamical systems. Applications of this approach to large-scale economic markets and power systems are discussed.

13534 (CONF-790904—P2, pp 59p, Section IV) **Solvability of large-scale descriptor systems.** Manke, J.W. (Boeing Computer Services Co., Seattle, WA). Oct 1979.

From Systems engineering for power: emergency operating state control conference; Davos, Switzerland (30 Sep 1979).

The report contains the results of the Boeing Computer Services Company research project SOLVABILITY OF LARGE SCALE DESCRIPTOR SYSTEMS, conducted as part of DOE research effort to identify and study modeling forms for large scale systems. The purpose of this project was to investigate numerical methods for the application of large scale descriptor systems to large, complex electric energy systems. Descriptor systems are particularly suited to large scale system problems because they preserve physical sparsity and provide a common formulation for the interconnection of subsystems with diverse physical properties.

13535 (CONF-790904—P2, pp 30p, Section V) **Towards a mathematical theory of modeling.** Corynen, G.C. (Univ. of California, Livermore); Aggarwal, S.; Hegner, S.J. Oct 1979.

From Systems engineering for power: emergency operating state control conference; Davos, Switzerland (30 Sep 1979).

The connection between a theory of composition (or decomposition) and modeling theory is considered. Uncovered were the important characteristics that allows one to be precise about when simplification of components of a base model allow an extrapolation to simplification of the composite model. It is shown that these results held for both the case of deterministic modeling as well as for probabilistic modeling. The concept of probabilistic modeling seems to be a more realistic one than weak or strong modeling since one is often faced with modeling performance uncertainties for which one has partial information - that is - for which probabilities may in fact be known. The probabilistic theorem shows that in this situation, one can still combine components into larger models and have some idea of the new modeling confidence, just as has been done for the deterministic case.

13536 (EPRI-EL—1187) **Vacuum arc commutator for resistive fault current limiter. Final report.** Dethlefsen, R.; Mylius, J. (Gould-Brown Boveri, Colmar, PA (USA)). Sep 1979. 84p. Dep. NTIS, PC A05/MF A01.

A triggered vacuum arc commutating switch, based on magnetic modulation, has been evaluated for application to a resistive fault current limiter at transmission voltages. A self-contained turn-on, turn-off switch has been demonstrated for the multi-MW power level. Up to 9 kA have been interrupted. Transient recovery voltages ranged up to 20 kV. Parallel shunt capacitance increases the interruption ability, particularly at higher source voltages.

13537 (N—79-17670) **Ultrasonic location of partial discharge and corona sources on transmission and generation plant.** Wilson, A.; Light, E.G. (Central Electricity Generating Board, London (UK)). Jun 1978. 4p. NTIS, PC A02/MF A01.

Several devices are described for use on electrical plants and their service environment. All rely on detection of ultrasound emitted from a breakdown source. Such sources within metal enclosed plant may be detected from vibrations to the enclosure. Sources not enclosed may be detected by collection of airborne sound using a high voltage probe or a parabolic reflector.

13538 (N—79-22619) **Space-based solar power conversion and delivery systems study. volume 3: microwave power transmission studies. Final report.** (Raytheon Co., Wayland, MA (USA). Equipment Div.). 1 Mar 1977. Contract NAS8-31308. 195p. NTIS PC A09/MF A01.

The Microwave Fower Beam Ionosphere effects and critical interfaces between th Microwave power Transmission System (MPTS) and the Satellite were studied as part of the NASA/MSFC continuing research on the feasibility of power transmission from geosynchronous orbit. Theoretical predications of ionospheric modifications produced by the direct interaction of the MPTS on the earth's upper atmosphere are used to determine their impact on the performance of the Microwave Power Beam and Pilot Beam System as well as on other RF systems effected by the ionosphere. A technology program to quantitatively define these interactions is developed. Critical interface areas between the MPTS and the sateilite which could have a major impact on cost and performance of the power system are idenfified and analyzed. The areas selected include: use of either a 20 kV versus 40 kV Amplitron, thermal blockage effects of Amplitron heat radiation by the satellite structure, effect of dielectric carry-through structure on power beam, and effect of material sublimation on performance of the Amplitron in Geosynchronous Orbit.

13539 (N—79-26334) **Transient attenuation of power supplies: a theoretical and practical evaluation of a power supply's ability to prevent coupling of transient from mains network into the dc output.** Duvaldchristensen, J.; Krebs, P. (Elektronikcentralen, Hoersholm (Denmark)). Jul 1978. 132p. NTIS, PC A07/MF A01.

The EMC design for fundamentals of power supplies pertaining to the reduction of the common mode coupling of small risetime transients from the ac power distribution network to the dc bus are outlined. A test method for the evaluation of power supply transient attenuation for all realistic installation modes is described. The method is ideal for time saving experimental optimization as the attenuation is displayed in real time as a frequency domain representation. To illustrate the problems connected with common mode transient attenuation, measurements on a standard power supply designed at Elektronikcentralen were carried out. It was demonstrated by circuit calculations and by measurements that only one generally applicable method exists to achieve a large common mode transient attenuation. That is inserting a choke with a very large first resonance in series with all leads entering the power supply from the ac distribution network.

13540 (N—79-26340) **Computation of the equilibrium points in an electric network with many machines calcolo dei punti di equilibrio di una rete elettrica a molte macchine.** Lacava, M.; Lacivita, C.D.; Nicosia, S. (Fondazione Ugo Bordoni, Rome (Italy)). Apr 1978. 41p. NTIS, PC A03/MF A01.

A multiple interconnected machine network, itself connected to an external network of infinite capacity, was studied. The differential equations were established assuming a third order model for each machine. The equilibrium points were identified by exploring several alternative methods. A procedure is suggested, based on the model, that requires less computing time, and has greater efficiency. A computer printout case is shown.

13541 **Dynamic economic dispatch of generation.** Ross, D.W.; Kim, S. (Syst Control, Inc, Palo Alto, Calif). pp 8p, Paper F 79 668-5 of 1979 IEEE summer power meeting. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From 1979 IEEE summer power meeting; Vancouver, Canada (Jul 1979).

A set of procedures and algorithms are developed for dynamic economic dispatch of generation units. When coupled with a short-term load predictor, "look-ahead" capability is provided by the dynamic economic dispatch that coordinates predicted load changes with the rate-of-response capability of generation units. Dynamic economic dispatch also enables valve-point loading of generation units. Two examples are provided which demonstrate that the approach overcomes the severe limits on the number of units that could be dynamically dispatched in past approaches. 11 refs.

AC SYSTEMS, EHV AND UHV

13542 **BPA's new generation of 500 kV lines.** Yasuda, E.J.; Dewey, F.B. pp 8p, Paper F 79 743-6 of 1979 IEEE summer power meeting. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From 1979 IEEE summer power meeting; Vancouver, Canada (Jul 1979).

After obtaining approximately seven years of operating experience, BPA initiated a major study in 1974 to review and re-evaluate the existing 500 kV line design parameters and criteria. Based on the results of this study, BPA designed a new generation of 500 kV lines. This report discusses the electrical and structural design parameters and criteria for BPA's new generation of 500 kV single and double circuit lines. Also discussed are cost savings of 10% for the new single circuit lines and 17% for the new double circuit lines.

13543 **Measurement of the electrical field at the Leningrad 750 kV substation.** Kaidanov, F.G. *Sov. Power Eng. (Engl. Transl.);* 7: No. 5, 288-291(May 1978).

Translated from Elektr. Stn.; 7: No. 5, 45-47(May 1978).

From experience in the operation of extra high voltage ac transmission lines it follows that prolonged presence of personnel at work sites near high voltage equipment and under bus bars at substations, as well as under overhead line conductors, involves unfavorable biological effects of the high voltage electrical field on the human body. At 500 and 750 kV substations near high voltage equipment the greatest field strength reaches 25 kV/m, and on pedestrian paths on the Konakovo-Moscow 750 kV transmission line in places the field strength reaches 20 kV/m. The purpose of their work was to make detailed measurements of the electrical field strength at the ground at the Leningrad substation and near the 750 kV line, to compare them with the calculation results, and to experimentally verify the effectiveness of the protective devices selected by calculation in the planning stage for the 750 kV distribution unit. The greatest electrical field strength was measured at a height of 1.8 meters above the ground under the flexible bus near the reactor and was 20 kV/m, and at an approach to an installed air breaker the maximum field strength was 11 kV/m. The calculated and measured zones are in acceptable agreement. In about 70% of the area of the working cells of the 750 kV distribution unit the electrical field strength exceeds 5 kV/m, exceeding 10 kV/m on about 30% of this area. Experimental testing of the effectiveness of the protective devices previously calculated for the design showed that they decrease the electrical field strength at work sites and pedestrian pathways significantly below the rated value.

DC SYSTEMS

REFER ALSO TO CITATION(S) 14425, 14426

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

REFER ALSO TO CITATION(S) 13628

13544 **Calculation of circulating current losses in cable conductors.** Kalsi, S.S.; Minnich, S.H. pp 6p, Paper F 79 604-0 of 1979 IEEE summer power meeting. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From 1979 IEEE summer power meeting; Vancouver, Canada (Jul 1979).

Conductors for power cable of large cross section are commonly built up from concentrically stranded bundles, which may be compacted to trapezoidal or sector shape. Concentric stranding does not constitute perfect transposition relative to the non-uniform self-field of the cable. While not normally significant at room temperature, the imperfect transposition can lead to large losses in cryogenic cables. A method for calculating the ac/dc ratio of a concentrically stranded, compacted bundle has been developed. On the basis of this method a conductor with 9.2 square inches of cross-section is designed for operation at liquid nitrogen temperature. To limit the overall ac/dc ratio of this conductor to 1.3, it is necessary to limit the strand bundle heights to values which require six layers for the conductor. A conductor of the same area designed for room temperature operation would require only two layers to limit its ac/dc ratio to 1.2. Provision for eliminating circulating currents among the six layers of the cryogenic cable conductor must be made.

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 13491, 13493, 13495, 13497, 13498, 13675

13545 (DOE/EIA—0184/24) **Commercial nuclear and uranium market forecasts for the United States and the world outside communist areas. Analysis report AR/ES/80-02.** Clark, R.G.; Reynolds, A.W. (Department of Energy, Washington, DC (USA). Energy Information Administration). Jan 1980. 60p. Dep. NTIS, PC A04/MF A01.

Nuclear power forecasts prepared by the Energy Information Administration (EIA) of the United States Department of Energy are presented. The domestic forecasts from the EIA Annual Report to Congress for 1978 (published in July 1979) are detailed for the two time frames considered in the EIA analytical hierarchy: the midterm, encompassing the 1985, 1990, and 1995 milestones and the long term, beyond 1995 to the year 2020. EIA nuclear forecasts for the balance of nations in the World Outside Communist Areas (WOCA) are also presented through the year 2000. In turn, an assessment is made of the uranium consumption requirements implied by both the domestic and WOCA nuclear power forecasts. A discussion is included of appropriate fuel cycle assumptions, sensitivities, and price projections.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 13573, 13574, 13582, 13593, 13595, 13600, 13605, 13614, 13615, 13622

13546 (EPRI-NP—1248) **Sensitivity and uncertainty analysis for the mixed-oxide thermal lattice U-L212.** Childs, R.L.; de Saussure, G.; Lucius, J.L.; Drischler, J.D.; Baker, V.C.; Marable, J.H.; Westfall, R.M. (Oak Ridge National Lab., TN (USA)). Dec 1979. Contract W-7405-ENG-26. 131p. Dep. NTIS, PC A07/MF A01.

The sensitivities of a mixed oxide ($2Wt\%PuO_2$ - 8% ^{240}Pu) fueled, light water moderated critical lattice experiment carried out at Battelle Northwest Laboratories under EPRI sponsorship have been determined. A two-dimensional diffusion theory analysis was performed and the sensitivity of the eigenvalue (k) and four reaction rate ratios to changes in nuclear data have been determined. The sensitivity analysis capability was extended to include upscattering and multi-dimension ability. A covariance matrix has been developed for ^{239}Pu, and the uncertainty associated with calculated performance parameters due to uncertainties in nuclear data has been obtained.

13547 DOE programs in radiation control for nuclear power plants. Pettit, P.J. (US DOE, Washington, DC). *Mater. Performance;* **18**: No. 6, 38-39(Jun 1979).

Programs being developed for the partial or complete removal of isotope contaminated corrosion products from BWR and PWR nuclear power plants, including the primary circulation system, are described. Identification of one or more cleaning processes, design and cost estimates for processes and prescribing testing programs to prove validity are contemplated. Projected decontamination of the Dresden reactor operated by Commonwealth Edison Co, is reviewed. Rapid decontamination is contemplated using organic acids and filtration.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 13546, 13547, 13566, 13573, 13574, 13582, 13595, 13600, 13602, 13605, 13606, 13611, 13613, 13614, 13618, 13622, 13625, 13626

13548 (EGG/LTR-LO—00-79-110) **Fast loop facility nitrogen injection system operation test .** Chen, T.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 3 Jan 1980. Contract EY-76-C-07-1570. 30p. Dep. NTIS, PC A03/MF A01.

The results are presented of the Nitrogen Injection System Operation test, which was run in the FAST Loop at LOFT Test Support Facility (LTSF) in the Idaho National Engineering Laboratory. The primary purpose of this test is to evaluate the feasibility of injecting the nitrogen gas into the FAST Loop Facility to simulate two-phase flow conditions for a later scheduled Pulse Neutron Activation (PNA) test, and determine the maximum attainable void fraction without causing severe damage to the main coolant pump. The test results indicate that the two-phase operation of FAST Loop is possible with injecting nitrogen but that the maximum void fraction should not exceed 35% for this type operation.

13549 (EPRI-NP—1142) **Experimental study of single- and two-phase flow fields around PWR steam generator tube support plates.** Bates, J.M.; Stewart, C.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1979. 104p. Dep. NTIS, PC A06/MF A01.

Laser-Doppler anemometry (LDA) was used to measure local mean axial velocities and turbulence intnsities at selected locations within a study model dimensionally protypic of an existing PWR steam generator design. The model tube bundle with support plate was installed in a special flow housing that formed part of an isothermal recirculating water flow loop. Flow conditions for this experiment were intended to simulate only typical single-phase flow velocities and were not an attempt to completely model actual steam generator, boiling, two-phase flow conditions. The measurements were performed in water at approximately 85°F with test section average velocities of approximately 0.55 and 1.1 fps. These conditions corresponded to Reynolds numbers of approximately 7,000 and approximately 14,000, respectively. Normalized velocity and turbulence intensity ratios are graphically reported. Additional qualitative, photographic investigations of air-water two-phase flows in a PWR steam generator study model were also performed.

13550 (UCRL—15140) **Potential seismic structural failure modes associated with the Zion Nuclear Plant. Seismic safety margins research program (Phase I). Project VI. Fragilities.** (Engineering Decision Analysis Co., Inc., Irvine, CA (USA)). Oct 1979. Contract W-7405-ENG-48. 111p. Dep. NTIS, PC A06/MF A01.

The Zion 1 and 2 Nuclear Power Plant consists of a number of structures. The most important of these from the viewpoint of safety are the containment buildings, the auxiliary building, the turbine building, and the crib house (or intake structure). The evaluation of the potential seismic failure modes and determination of the ultimate seismic capacity of the structures is a complex undertaking which will require a large number of detailed calculations. As the first step in this evaluation, a number of potential modes of structural failure have been determined and are discussed. The report is principally directed towards seismically induced failure of structures. To some extent, modes involving soil foundation failures are discussed in so far as they affect the buildings. However, failure modes involving soil liquefaction, surface faulting, tsunamis, etc., are considered outside the scope of this evaluation.

13551 (UCRL—15155) **Technical evaluation of the electrical, instrumentation, and control design aspects of the override of containment purge valve isolation and other engineered safety feature signals for the Joseph M. Farley Nuclear Power Plant.** Hackett, D.B. (EG and G, Inc., San Ramon, CA (USA). Energy Measurements Group). Nov 1979. Contract EY-76-C-08-1183. 14p. (EGG—1183-4146). Dep. NTIS, PC A02/MF A01.

The technical evaluation is presented for the electrical, instrumentation, and control design aspects of the override of containment purge valve isolation and other engineered safety feature signals for the Joseph M. Farley nuclear power plant. The review criteria are based on IEEE Std-279-1971 requirements for the safety signals to all purge and ventilation isolation valves.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 13577, 13585, 13587, 13607, 13898

13552 (GA-A—15501) **3000 MW(t) HTGR - gas turbine non-intercoolel. Technical evaluation report.** (General Atomic Co., San Diego, CA (USA)). Dec 1979. Contract AT03-76SF70046. 297p. Dep. NTIS, PC A13/MF A01.

This report summarizes all the technical work performed on the 3000-MW(t) 3-loop High-Temperature Gas-Cooled Reactor Gas Turbine design as of June 1979. Although the plant configuration has changed to a 2000-MW(t) 2-loop plant, most of the technical assessments described in this report are still applicable to the 2000-MW(t) plant. The report covers the criteria under which the plant was designed, the technical feasibility problems associated with the plant and their potential solutions, and other potential applications and improvements which could make the gas turbine concept more attractive economically.

13553 (GA-A—15565) **Effects of methane concentration on the controlled-impurity helium corrosion behavior of selected HTGR structural materials.** Johnson, W.R.; Thompson, L.D. (General Atomic Co., San Diego, CA (USA)). Dec 1979. Contract AT03-76ET35300. 64p. Dep. NTIS, PC A04/MF A01.

The corrosion behavior of candidate structural alloys in a series of three simulated advanced gas-cooled reactor environments

at 900°C (1652°F), with methane concentration varied, is discussed. The alloys investigated include three wrought alloys, Hastelloy X, Inconel 617, and Incoloy 800H; two cast superalloys, Rene 100 and IN 713; one centrifugally cast alloy, HK 40; and an oxide-dispersion-strengthened alloy, MA 754. Corrosion behavior was found to be strongly dependent upon both the alloy chemistry and the environment. Oxidation, carburization, and/or mixed behavior was observed depending upon the specific conditions. An equilibrium thermodynamics approach has been used to predict alloy behavior and explain observations relevant to the understanding of gas/metal interactions in reactor helium, which inherently contains small amounts of reactive impurity species. Carburization was identified as the primary corrosion phenomenon of concern, and detailed analyses were performed to determine the susceptibility and control of carburization reactions. The presence of alumina scales, containing small amounts of titanium, was found to be particularly effective in inhibiting carburization. Small variations in methane concentration have been shown to have a dramatic effect upon the oxidation potential and subsequent corrosion behavior of the alloy systems.

13554 (NUREG/CR—1006) **Preliminary design study of a large scale graphite oxidation loop.** Epel, L.G.; Majeski, S.J.; Schweitzer, D.G.; Sheehan, T.V. (Brookhaven National Lab., Upton, NY (USA)). Aug 1979. Contract EY-76-C-02-0016. 36p. (BNL-NUREG—51054). Dep. NTIS, PC A03/MF A01.

A preliminary design study of a large scale graphite oxidation loop was performed in order to assess feasibility and to estimate capital costs. The nominal design operates at 50 atmospheres helium and 1800 F with a graphite specimen 30 inches long and 10 inches in diameter. It was determined that a simple single walled design was not practical at this time because of a lack of commercially available thick walled high temperature alloys. Two alternative concepts, at reduced operating pressure, were investigated. Both were found to be readily fabricable to operate at 1800 F and capital cost estimates for these are included. A design concept, which is outside the scope of this study, was briefly considered.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 13575

13555 (AECL—6176) **Acoustic analysis of hydrodynamic oscillations in the Gentilly-1 steam mains.** Selander, W.N.; Wong, P.Y. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nov 1978. 43p. Dep. NTIS (US Sales Only), PC A04/MF A01.

A small amplitude (acoustic) wave equation is used to investigate pressure oscillations in the Gentilly-1 primary steam network, in both its existing form, and with the proposed modifications for LaPrade Heavy Water Plant. The equations are solved in two basic approximations. In the first approximation, damping and bulk steam motion are ignored and the resonant frequencies and mode shapes of the network are evaluated. In the second approximation damping and flow effects are included, and the frequency response of the network to a specific disturbance is found. The predicted results show good agreement with observations on the existing system, which gives some confidence in the predictions for the modified network.

13556 (AECL—6213) **CANDU fuel performance and development.** Hardy, D.G.; Wood, J.C.; Bain, A.S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1978. 18p. (CONF-7806125—4). Dep. NTIS (US Sales Only), PC A03/MF A01.

From 1978 annual conference of the Canadian Nuclear Association; Ottawa, Canada (11 Jun 1978).

The fuel defect rate in CANDU (Canada Deuterium Uranium) reactors continues to be very low, 0.06% since 1972. The power ramp defects, which constituted the majority of the early defects, have been virtually eliminated by changed fuelling schemes and through the introduction of graphite CANLUB coatings on the inside of the sheath. Laboratory and loop irradiations have demonstrated that the graphite CANLUB layers increase the tolerance to power ramps, but to obtain the maximum benefit, coating parameters such as thickness, adhesion and wear resistance must be optimized. Siloxane CANLUB coated fuel offers greater tolerance to power ramps than most graphite coatings; quality control appears simpler and no instance of localized sheath hydriding has been seen with cured and irradiated coatings. Limited testing has shown that fuel with graphite discs between fuel pellets also has high tolerance to power ramps, but it is more costly and has lower burnup. The number of defects due to faulty components has been extremely small (0.00014%), but improved quality control and welding procedures can lower this number even further. Defects from causes external to the bundle have also been very few.

13557 (AECL—6403) **Basic concepts of a fuel-power detector for nuclear power reactors.** Lynch, G.F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jan 1979. 9p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Fuel power is proposed as an alternative to neutron or gamma-ray flux for control and safety functions in CANDU power reactors. To satisfy in-core power monitoring requirements, a detector whose dynamic response corresponds to the heat production rate in the fuel is needed. This report explores the concept of tailoring the response characteristics of a mixed-response self-powered flux detector to match the requirements of an ideal fuel-power detector.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 13576, 13578, 13579, 13601, 13604, 13610, 13612, 13627, 13904

13558 (ANL/ENG—80-02) **Study of piping configurations.** Pan, Y.; Rafer, A.; Ahmed, H. (Argonne National Lab., IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 34p. Dep. NTIS, PC A03/MF A01.

A study of piping and elbow flexibility is performed using an analytical approach and piping analysis computer programs ADL-PIPE and MARC. The study focuses on pipe loop configurations commonly used to accommodate thermal expansion in such applications as Liquid Metal Fast Breeder Reactors.

13559 (HEDL-SA—1839) **Thermal bowing of wire-wrapped fuel pins in fast reactors.** Chan, D.P.; Jackson, R.J. (Hanford Engineering Development Lab., Richland, WA (USA)). 1979. Contract EY-76-C-14-2170. 24p. (CONF-791103—68). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The mechanism of thermal bowing of fuel pins is discussed. Finite element models for thermal bowing analysis using MARC-CDC and BEAMCREEP programs are presented. Analytical results are in reasonably close agreement with each other. Thermal bowings of edge fuel pins in various FTR core positions are predicted. Conservative predictions indicate that the reference edge pins with 30.48 cm (12 in.) axial pitch may touch the duct wall in as little as 1000 h or irradiation. The results further indicate that the axial stress induced in the cladding by thermal bowing is 4 times as much as that due to fission gas release. However, the combined axial stress level is still below that to cause stress rupture in the design life of the pin.

13560 (ORNL/TM—7043) **ORCULT-I: a loop dynamics simulator program for the core flow test loop.** Ball, S.J. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 58p. Dep. NTIS, PC A04/MF A01.

A digital simulation program, ORCULT-I, was developed to predict both the steady-state and transient behavior of the core flow test loop (CFTL). ORCULT has been used to answer design questions concerning loop configurations, operating modes, bundle tests, and postulated loop-accident conditions. The CFTL is a thermal-hydraulic and structural test vehicle for performance evaluations of Gas-Cooled Fast-Breeder Reactor (GCFR) fuel-rod bundle designs. The status, capabilities, and limitations of ORCULT are described, and several sample transients are shown which demonstrate characteristics of CFTL behavior. The appendix of the report includes derivations of the model equations used in ORCULT.

13561 (ORNL/TM—7091) **Analysis of fission-product effects in a Fast Mixed-Spectrum Reactor concept.** White, J.R.; Burns, T.J. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

The Fast Mixed-Spectrum Reactor (FMSR) concept has been proposed by BNL as a means of alleviating certain nonproliferation concerns relating to civilian nuclear power. This breeder reactor concept has been tailored to operate on natural uranium feed (after initial startup), thus eliminating the need for fuel reprocessing. The fissile material required for criticality is produced, in situ, from the fertile feed material. This process requires that large burnup and fluence levels be achievable, which, in turn, necessarily implies that large fission-product inventories will exist in the reactor. It was the purpose of this study to investigate the effects of large fission-product inventories and to analyze the effect of burnup on fission-product nuclide distributions and effective cross sections. In addition, BNL requested that a representative 50-group fission-product library be generated for use in FMSR design calculations.

13562 (PNL—3249) **Mass flows for LMFBRs fueled with various types of plutonium and fertile material.** Jenquin, U.P. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 39p. Dep. NTIS, PC A03/MF A01.

Results are presented of neutronics analyses performed to determine fueling requirements and mass flows for a typical 1200 megawatt electric (MWe) liquid metal fast breeder reactor

(LMFBR). In performing the analyses, three plutonium compositions were considered to fuel the reactor. The composition depended on the amount of irradiation either a UO_2 or PuO_2-ThO_2 fuel had received in a light water reactor (LWR). Uranium and thorium fertile materials were considered. Calculations were performed to determine the cross sections, reactivity, and burnup for each fuel-fertile material configuration. Based on these calculations, the mass flows, plutonium enrichment requirements, and breeding ratios for each configuration were determined.

13563 (PNL-SA—7503) **Initial stage restructuring in sphere-pac mixed-carbide fuel.** Guenther, R.J.; Peddicord, K.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 10p. (CONF-790306—25). Dep. NTIS, PC A02/MF A01.

From International conference on fast breeder reactor performance; Monterey, CA, USA (5 Mar 1979).

The analysis of sintering models and mechanisms for mixed-carbide sphere-pac fuel has shown that volume diffusion is the dominant mechanism. The actual diffusion path is not clearly defined but the importance of small pressures in increasing neck growth is apparent. The time dependence of the neck ratios indicates that significant restructuring occurs within 5.6 hours which may be used as a bench mark for the beginning of pore migration.

13564 (PNL-SA—7521) **CORTRAN code for temperature predictions in an LMFBR during a natural circulation transient.** Khan, E.U.; Hinds, A. (Battelle Pacific Northwest Labs., Richland, WA (USA); Argonne National Lab., IL (USA)). Jan 1979. Contract EY-76-C-06-1830. 6p. (CONF-790602—92). Dep. NTIS, PC A02/MF A01.

From ANS annual meeting; Atlanta, GA, USA (3 Jun 1979).

Three transient thermal-hydraulic models, TRAN I, II, III, have been incorporated into the CORTRAN code. The TRAN I, II, III models are similar in as much as they retain the wire-wrap mixing and swirl flow models of the Energy code, i.e., the wire-wrap mixing is modeled by an enhanced eddy diffusivity in the central regions of the bundle and a swirl flow in the region near the duct wall. The fuel rod and duct wall models required to treat the stored heat and thermal inertia effects, are also similar in the three models. Up to 10 radial nodes are allowed in the rods and 6 radial nodes in the duct wall to solve the one-dimensional conduction equation for the rods and duct wall, by finite difference. Temperature-dependent properties are taken into account in calculating rod temperatures.

13565 (WAPD-TM—1336) **Results of initial nuclear tests on LWBR (LWBR Development Program).** Sarber, W.K. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jun 1979. Contract EY-76-C-11-0014. 173p. Dep. NTIS, PC A08/MF A01.

This report presents and discusses the results of physics tests performed at beginning of life on the Light Water Breeder Reactor (LWBR). These tests have confirmed that movable seed assembly critical positions and reactivity worths, temperature coefficients, xenon transient characteristics, core symmetry, and core shutdown are within the range of values used in the design of the LWBR and its reactor protection analysis. Measured core physics parameters were found to be in good agreement with the calculated values.

13566 (WAPD-TM—1412) **Corrosion and hydriding performance evaluation of three zircaloy-2 clad fuel assemblies after continuous exposure in PWR cores 1 and 2, at Shippingport, PA.** Hillner, E. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jan 1980. Contract EY-76-C-11-0014. 69p. Dep. NTIS, PC A04/MF A01.

Three original Zircaloy-2 clad blanket fuel bundles from the pressurized water reactor (PWR) at the Shippingport Atomic Power Station were discharged after continuous exposure during Cores 1 and 2. Detailed visual examination of these components after ~ 6300 calendar days of operation (51,140 EFPH) revealed only the anticipated uniform light gray (post-transition) corrosion products with no evidence of unexpected corrosion deterioration, fuel rod warpage, or other damage. All corrosion films were found to be tightly adherent to the underlying cladding. An extensive destructive examination of a selected fuel rod from each of three fuel bundles produced appreciably greater end-of-life rod average oxide film thickness when compared with corresponding values produced from a set of empirical equations generated from the out-of-pile (autoclave) testing of Zircaloy coupons.

13567 (WAPD-TM—1426) **Out-of-pile accelerated hydriding of Zircaloy fasteners.** Clayton, J.C. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1979. Contract EY-76-C-11-0014. 173p. Dep. NTIS, PC A08/MF A01.

Mechanical joints between Zircaloy and nickel-bearing alloys, mainly the Zircaloy-4/Inconel-600 combination, were exposed to water at 450°F and 520°F to study hydriding of Zircaloy in contact with a dissimilar metal. Accelerated hydriding of the Zircaloy occurred at both temperatures. At 450°F the dissolved hydrogen level of the water was over ten times that at 520°F. At 520°F the initially high hydrogen ingress rate decreased rapidly as exposure time increased and was effectively shut off in about 25 days. Severely hydrided Zircaloy components successfully withstood thermal cycling and mechanical testing. Chromium plating of the nickel-bearing parts was found to be an effective and practical barrier in preventing nickel-alloy smearing and accelerated hydriding of Zircaloy.

13568 (JAPFNR—460) **Progress report on fast breeder reactor development in Japan, July-September 1978.** (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Apr 1979. Translation of PNC-N—251-79-02. 16p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Work performed under United States - Japanese Fast Reactor Exchange Program.

Information is presented concerning development of the JOYO reactor; development of the MONJU reactor; reactor physics; structural components for the JOYO and MONJU reactors; instrumentation and control; sodium technology; fuel materials; structural materials; safety; and steam generator.

13569 **Perceptions of risks and timing in breeder development decisions.** Braun, C. (Electr Power Res Inst, Palo Alto, Calif). *Am. Soc. Mech. Eng., [Pap.]*; No. 79-JPGC-NE-4, 1-13(1979).

This paper considers the role of the breeder from an electric utility point of view. FBRs will be required as a capacity option, in order to maintain flexibility in the choice of the future generation mix. The uncertainties in electric demand growth rate, and the availability of other power technologies, indicate that foreclosing the breeder option now would not represent a prudent generation planning policy. Three conclusions are evident: There exists a need now to proceed with a well focused breeder RandD program, so that this technology is available when required. The upside risk of not having the FBR option ready on time, far outweighs the downside risk of accelerated rather than reduced FBR development effort. Even with active pursuit of the FBR program, there exists sufficient time to develop and improve the institutional arrangements required to safeguard this electric generation option. 20 refs.

POWER REACTORS, AUXILIARY, MOBILE, PACKAGE, AND TRANSPORTABLE

REFER ALSO TO CITATION(S) 13321, 13587

REGULATION AND LICENSING

13570 **Rules and regulations in the nuclear field.** Kraut, A. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). pp 9-11 of Welding in nuclear engineering. Duesseldorf, Germany, F.R.; Deutscher Verl. fuer Schweisstechnik (1978). (In German)

From 3. international colloquium on welding in nuclear engineering; Hamburg, F.R. Germany (28 Nov 1978).

A summary of the existing regulations and technical standards, information about the activities of international rule-making organizations, and reference to extended documents are presented.

13571 (RDT-F—8-6T(Rev.)) **Hoisting and rigging of critical components and related equipment.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). Jan 1980. Contract W-7405-ENG-26. 47p. RSO.

This standard covers hoisting and rigging of large coolant system components such as pumps and heat exchangers, fuel elements, and other critical components, and also of any materials, equipment, or supplies handled over, in, or around spaces in which such critical items are located. The standard specifies minimal requirements for hoisting and materials handling equipment and for tackle; requirements, recommendations, and precautions in their use; and tests and inspections to verify that they are in good operating condition and can safely and reliably accommodate the loads involved under the operational conditions that will prevail. The purpose of this standard is to minimize the likelihood of physical damage to critical items due to dropping, upset, impact, or other accident.

ECONOMICS

REFER ALSO TO CITATION(S) 13552

13572 (DOE/NE—0001) **Nuclear proliferation and civilian nuclear power: report of the nonproliferation alternative systems assessment program. Volume V. Economics and systems analysis.** (Department of Energy, Washington, DC (USA)). Dec 1979. 100p. Dep. NTIS, PC A05/MF A01.

This NASAP assessment considers the economics of alternative nuclear reactor and fuel-cycle systems in the light of possible patterns of uranium supply and energy demand, as well as the economic implications of improving the proliferation resistance of the various systems. The assessment focuses on the costs of alternative nuclear technologies and the possible timing of their implementation, based on their economic attractiveness. The objectives of this assessment are to identify when economic incentives to deploy advanced nuclear power systems might exist, to estimate the costs of using technologies that would reduce the risk of proliferation, to assess the impact of major economic uncertainties on the transition to new technologies, and to compare the investments required for alternative systems.

FUEL CYCLE

REFER ALSO TO CITATION(S) 13181

13573 (COO—4570-T1) **Evaluation of improved light water reactor core designs. Final progress report, September 1979. LWRCD-20.** (Massachusetts Inst. of Tech., Cambridge (USA)). 31 Oct 1979. Contract EN-77-S-02-4570. 13p. Dep. NTIS, PC A02/MF A01.

The work conducted under this research project has developed information which supports in all respects the U.S. position evolved under the NASAP/INFCE programs with respect to the near and intermediate term potential for ore conservation in LWRs on the once-through fuel cycle. Moreover, in the even longer term, it has been confirmed that contention by Edlund and others that tight-pitch Pu/UO_2 PWR cores can achieve conversion ratios which may allow these reactors to provide a competitive energy source far into the ore-scarce post-2000 era.

13574 (DOE/NE—0003/1) **Light-water reactors: preliminary safety and environmental information document. Volume I.** (Department of Energy, Washington, DC (USA)). Jan 1980. Contract W-31-109-ENG-38;W-7405-ENG-26. 221p. Dep. NTIS, PC A10/MF A01.

Information is presented concerning the reference PWR reactor system; once-through, low-enrichment uranium-235 fuel, 30 MWD per kilogram (PWR LEU(5)-OT); once-through, low-enrichment, high-burnup uranium fuel (PWR LEU(5)-Mod OT); self-generated plutonium spiked recycle (PWR LEU(5)-Pu-Spiked Recycle); denatured uranium-233/thorium cycle (PWR DU(3)-Th Recycle DU(3)); and plutonium/thorium cycle (Pu/ThO_2 Burner).

13575 (DOE/NE—0003/2) **Heavy-water reactors: preliminary safety and environmental information document. Volume II.** (Department of Energy, Washington, DC (USA)). Jan 1980. Contract W-31-109-ENG-38;W-7405-ENG-26. 130p. Dep. NTIS, PC A07/MF A01.

Information is presented concerning the modifications relative to the CANDU reactor; and a once-through fuel cycle with 1.2% enriched uranium-235 and a burnup of 20,000 MWd/MT.

13576 (DOE/NE—0003/3) **Light-water breeder reactors: preliminary safety and environmental information document. Volume III.** (Department of Energy, Washington, DC (USA)). Jan 1980. Contract W-31-109-ENG-38;W-7405-ENG-26. 178p. Dep. NTIS, PC A09/MF A01.

Information is presented concerning prebreeder and breeder reactors based on light-water-breeder (LWBR) Type 1 modules; light-water backfit prebreeder supplying advanced breeder; light-water backfit prebreeder/seed-blanket breeder system; and light-water backfit low-gain converter using medium-enrichment uranium, supplying a light-water backfit high-gain converter.

13577 (DOE/NE—0003/4) **High-temperature gas-cooled reactors: preliminary safety and environmental information document. Volume IV.** (Department of Energy, Washington, DC (USA)). Jan 1980. Contract W-31-109-ENG-38;W-7405-ENG-26. 219p. (P). Dep. NTIS, PC A10/MF A01.

Information is presented concerning medium-enriched uranium/thorium once-through fuel cycle; medium-enrichment uranium-233/thorium recycle fuel; high-enrichment uranium-235/thorium recycle (spiked) fuel cycle; high-enrichment uranium-233/thorium recycle (spiked) fuel cycle; and gas-turbine high-temperature gas-cooled reactor.

13578 (DOE/NE—0003/5) **Gas-cooled fast reactors: preliminary safety and environmental information document. Volume V.** (Department of Energy, Washington, DC (USA)). Jan 1980. Contract W-31-109-ENG-38;W-7405-ENG-26. 114p. Dep. NTIS, PC A06/MF A01.

Information is presented concerning a homogeneous plutonium/uranium oxide core with thorium oxide axial and radial blankets and spiked recycle.

13579 (DOE/NE—0003/6) **Liquid-metal fast-breeder reactors: Preliminary safety and environmental information document. Volume VI.** (Department of Energy, Washington, DC (USA)). Jan 1980. 175p. Dep. NTIS, PC A08/MF A01.

Information is presented concerning LMFBR design characteristics; uranium-plutonium/uranium recycle homogeneous core; uranium-plutonium/uranium spiked recycle heterogeneous core; uranium-plutonium/uranium spiked recycle homogeneous core; uranium-plutonium/thorium spiked recycle heterogeneous core; uranium-plutonium/thorium spiked recycle homogeneous core; thorium-plutonium/thorium spiked recycle homogeneous core; denatured uranium-233/thorium cycle homogeneous core; safety consideration for the LMFBR; and environmental considerations.

13580 (DOE/NE—0003/7) **Fuel-cycle facilities: preliminary safety and environmental information document. Volume VII.** (Department of Energy, Washington, DC (USA)). Jan 1980. Contract W-31-109-ENG-38;W-7405-ENG-26. 223p. Dep. NTIS, PC A10/MF A01.

Information is presented concerning the mining and milling of uranium and thorium; uranium hexafluoride conversion; enrichment; fuel fabrication; reprocessing; storage options; waste disposal options; transportation; heavy-water-production facilities; and international fuel service centers.

13581 (HEDL-TME—79-13) **FUELOG: a system dynamics model of the nuclear fuel cycle.** Fields, S.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1980. Contract EY-76-C-14-2170. 95p. Dep. NTIS, PC A05/MF A01.

FUELOG, a system dynamics model of the nuclear fuel cycle, has been developed to a preliminary phase. FUELOG, a hierarchically structured model programmed in the Advanced Continuous Simulation Language (ACSL), is designed to facilitate comprehensive evaluations of the nuclear fuel cycle or of sselected facets of the cycle.

13582 (ORNL/SUB—7494/1) **NASAP: a computer code for the evaluation of the Non-proliferation Alternative Systems Assessment Program concepts. Final report in support of Task 2.** Maul, B.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). Sep 1979. Contract W-7405-ENG-26. 143p. (WCAP—9539). Dep. NTIS, PC A07/MF A01.

The Non-Proliferation Alternative Systems Assessment Program (NASAP) computer code was developed to calculate the LWR and NASAP choice reactor cost through an arbitrary year T/ sub N/. The final cost is arrived at by calculation of cost contributory factors for both LWR and NASAP choice reactors.

13583 **Beyond the light water reactor.** Nero, A.V. Jr. (Univ. of California, Berkeley). *Bull. At. Sci.;* **36**: No. 2, 31-37(Feb 1980).

One of the strong interests in examining alternative nuclear fuel cycles is to search for schemes that are more efficient than LWRs in their use of uranium, but that do not carry the additional proliferation hazard associated with widespread plutonium utilization. One possibility is to improve the uranium efficiency of current reactor types by other means than recycling. A second possibility, offering greater potential for improvement, is to utilize thorium-uranium fuel cycles in which uranium-233 is denatured by the addition of uranium-238, making enrichment necessary to yield weapons-usable material. The bulk of the reactor's fuel material would be thorium-232, so that most of the fissile material produced would be uranium-233. It is important to recognize that these two possibilities - once through improvements and denatured thorium-uranium - could be introduced sequentially in reactor types that are currently in use. Fuel cycles may change over time, but it is equally significant from the point of view of non-proliferation that they will also vary from place to place and, most importantly, from country to country. The author argues that alternative nuclear power systems and a slower growth may affect the diversion of nuclear materials to weapons. A real question, though, is whether we have time to explore the possibilities. It has become apparent that predictions made of the growth rate for nuclear power were too high. The 1000 large power plants the US was to have by the year 2000 have been reduced to fewer than 300. This reduces the pressure, resulting from our limited uranium resources, to push the LMFBR. Extra time gives us a chance to examine the possibilities. (MCW)

PROCESS HEAT REACTORS

13584 (GA-A—15712) **Production of liquid fuels with a high-temperature gas-cooled reactor.** Quade, R.N.; Vrable, D.L.; Green, L. Jr. (General Atomic Co., San Diego, CA (USA)). Dec 1979. Contract AT03-76SF10610. 14p. (CONF-791204—17). Dep. NTIS, PC A02/MF A01.

From 2. Miami international conference on alternative energy sources; Miami Beach, FL, USA (10 Dec 1979).

Recent events by OPEC have sharply increased interest in the United States for synfuels, and there are plans for several types of synfuel demonstration plants. The early timing of these plants will probably preclude their use of a nuclear heat source, but their operation will be a necessary step to the eventual integration of a

nuclear heat source. The applications using coal liquids that are considered active candidates for nuclear process heat, the reference heat source design, and nuclear and non-nuclear methods for coal liquefaction are described.

13585 (GEFR-SP—170) **Application of a high temperature gas cooled nuclear reactor for the production of secondary energy sources and chemicals.** Flock, J.W.; Kosky, P.G. (General Electric Co., Schenectady, NY (USA)). 1979. Contract EN-77-C-02-4057;EY-76-C-02-2676. 33p. (CONF-7909116—1). Dep. NTIS, PC A03/MF A01.

From American Gas Association synthetic fuels committee meeting; Miami Beach, FL, USA (12 Sep 1979).

The Department of Energy has funded studies of the use of High Temperature Gas Cooled Nuclear Reactors (HTR) to supply energy to convert raw chemicals to useful secondary energy carriers and chemical products. The helium-cooled, graphite-moderated HTR is a unique source for such primary energy in that it is capable of delivering heat at high temperatures. There are currently two candidate HTR designs. Favored in the US is General Atomic's Prismatic Core HTR such as commercially installed at Fort St. Vrain. Under development in West Germany is a prototype Pebble Bed Reactor (PBR). Two primary applications of HTR heat have been considered. These are the Thermochemical Energy Pipeline (TCP) and diverse coal conversion processes.

NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 13959

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 14479

13586 (INIS-mf—4983) **Contributions to the elaboration of a nuclear data set for fast reactors.** Petre, I. (Institutul de Fizica si Inginerie Nucleara, Bucharest (Romania)). 1977. 23p. (In Romanian). Dep. NTIS (US Sales Only), PC A03/MF A01.

A set of nuclear data was calculated for fast reactors based on an "optimum agreement" with experimental data. It allows a better approach to a fast reactor project, since both integral and differential data were employed to draw it up. The mathematical method used consists in modifying differential data in view of obtaining a minimum disparity between integral calculated and measured values. The original contribution of the thesis lies in a statistical substantiation of the calculation method. For this purpose, a minimum theorem was demonstrated and the statistical behaviour of the Lagrange multipliers vector as well as the section estimated set were investigated, demonstrating the character of non-biassed estimator. There were also contributions to the formalism for sensitivity coefficients by developing the variational method, generalizing the Swanlake method and writing the sensitivity calculations under a form consistent with the ANISN code. In the last part, the calculation code for the improved nuclear data set is presented using element U^{235} as a calculating example. The code was run on IBM-370 and PDP-15 computers (with a limited number of integral data). Section corrections for ZPR-III systems of 400 Kg, 200 Kg and 150 Kg critical mass were calculated.

13587 (LA—8160-PR) **Reactor technology. Progress report, July-September 1979.** Breslow, M.; Sullivan, S. (eds.). (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 150p. Dep. NTIS, PC A07/MF A01.

Information is presented concerning the space reactor electric power supply; gas-cooled reactor safety; heat pipe technology development; and nuclear criticality experiments and safety.

13588 (NUREG/CR—0987) **SANDIA-ORIGEN user's manual.** Bennett, D.E. (Sandia Labs., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 98p. (SAND—79-0299). Dep. NTIS, PC E03/MF E03.

The SANDIA-ORIGEN code calculates the detailed isotopic composition as a function of time in nuclear reactor fuel irradiation and radioactive decay problems. This code was developed specifically for Control Data Corporation computers from the original Oak Ridge National Laboratory ORIGEN code. The nuclear data file used with the code at Sandia Laboratories contains 1063 isotopes (254 structural materials, 101 actinides, and 708 fission products). SANDIA-ORIGEN is oriented toward simple, easy use and includes NAMELIST input, convenient control of the output, and versatile options for the blending and reprocessing of reactor fuel. System operating instructions and the input decks for numerous sample problems are also presented. 13 references, 14 figures.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 13899, 14133

13589 (NUREG/CR—0933) **Improvement in the calculation of turbulent friction in smooth concentric annuli.** Jones, O.C. Jr.; Leung, J.C.M. (Brookhaven National Lab., Upton, NY (USA)). Aug 1979. Contract EY-76-C-02-0016. 29p. (BNL-NUREG—51025). Dep. NTIS, PC A03/MF A01.

Data and calculation techniques for frictional pressure loss in smooth, concentric annuli are reviewed. It is shown that the accepted methods of Meter and Bird, and of Rothfus, Monrad, and Senecal deviate by 4% and 8%, respectively, from the correct limit for small gaps. Further, neither correctly predicts the data trends with decreasing radius ratio. It is further shown that the data upon which the Meter and Bird correlation was based in part was probably deficient due to strong secondary flow caused by the unrestricted exit tee. Finally, the method of Jones, previously applied to rectangular ducts, has been extended to smooth, concentric annuli. It is shown that both the trends and the limiting behavior are quantitatively correct.

13590 (NUREG/CR—1199) **Subcompartment analysis procedures.** Gido, R.G.; Gilbert, J.S.; Tinkler, C.G. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 68p. (LA—8169-MS). Dep. NTIS, PC A04/MF A01.

Procedures for the performance of nuclear reactor subcompartment analysis are presented. The purpose of this presentation is to normalize the analysis procedures and provide a standard approach for such analyses. As a result, differences in the manner of performing subcompartment analyses hopefully will be minimized and more readily understood and evaluated by others. The procedures were developed within the constraint of current code capability for the performance of such analyses and the current US NRC guidelines. A wide gamut of the effect of input and modeling variations on calculated forces and moments were studied. The studies were primarily for representative reactor cavity geometries. The COMPARE subcompartment analysis code was used for the studies.

FUEL ELEMENTS

13591 (AE-TPM-BL—121) **Fission product migration in intact fuel rods S176 experiments 1-5: Estimation of fuel temperatures during irradiation.** Blackadder, W.H.; Kilter, J.; Malen, K. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Nov 1977. 23p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This work is part of a project, the aim of which is to provide information on the distribution of fission products in intact irradiated fuel rods, both within the UO_2 fuel and on the inside of the zircaloy clad. Fuel rods, previously irradiated to appreciable burnups in the Aagesta R3 reactor, after cooling, are re-irradiated in the Studsvik R2 test reactor for short periods to build up significant inventories of short-lived fission products of interest. The irradiation conditions are well defined. The parameter of greatest importance for the migration is the temperature. For this reason temperature distributions have been calculated using a computer code. Grain growth measurements have also been made. The grain growth data typically yield a 5-10 % higher temperature than the calculations with a scatter of the same amount (5-10 %) about the mean.

13592 (AE-TPM-BL—124) **Fission product migration in intact fuel rods S176 experiments 1-5: Metallography results.** Wikstroem, C.; Blackadder, W.H.; Malen, K. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Nov 1977. 33p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This work is part of a project, the aim of which is to provide information on the distribution of fission products in intact irradiated fuel rods, both within the UO_2 fuel and on the inside of the zircaloy clad. Fuel rods, previously irradiated to appreciable burnups in the Aagesta R3 reactor, after cooling, are re-irradiated in the Studsvik R2 test reactor for short periods to build up significant inventories of short-lived fission products of interest. The irradiation conditions are well defined. In this report the results from the ceramographic analyses of the fuel rods are presented together with the beta autoradiography results.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 13552

SITING

13593 (PB—295904) **Power plant site evaluation, aquatic biology - Douglas Point Site. Volume 2. Final report.** (Ecological Analysts, Inc., Baltimore, MD (USA)). Nov 1974. 505p. NTIS PC A22/MF A01.

This is part of a series of reports containing an evaluation of the proposed Douglas Point Nuclear Generating station site located on the Potomac River in Maryland 30 miles south of Washington, D.C. This report presents background information and the results of a data collection program in 1973 and 1974 in the areas of water quality, geochemistry, phytoplankton, zooplankton, benthic invertebrates, and fisheries.

13594 **Evaluating methodologies: A procedure and application to nuclear power plant siting methodologies.** Ford, C.K.; Keeney, R.L.; Kirkwood, C.W. (Sandia Lab). *Manage. Sci.;* **25**: No. 1, 1-10(Jan 1979).

A procedure is presented to evaluate the appropriateness of alternative methodologies for analyzing a specified problem. This procedure is illustrated by identifying desirable characteristics of nuclear power plant site selection methodologies and evaluating the adequacy of methodologies that have been used to select nuclear power plant sites. Objectives of such siting methodologies are specified and attributes developed to measure the degree of attainment of each objective. Several siting methodologies are rated on the various attributes and these ratings are analyzed to determine the adequacy of each methodology.

RADIOACTIVE EFFLUENTS

13595 (PNL—2286(App.)) **Descriptions of reference LWR facilities for analysis of nuclear fuel cycles. Appendixes.** Schneider, K.J.; Kabele, T.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1979. Contract EY-76-C-06-1830. 232p. Dep. NTIS, PC A11/MF A01.

The appendixes present the calculations that were used to derive the release factors discussed for each fuel cycle facility in Volume I. Appendix A presents release factor calculations for a surface mine, underground mine, milling facility, conversion facility, diffusion enrichment facility, fuel fabrication facility, PWR, BWR, and reprocessing facility. Appendix B contains additional release factors calculated for a BWR, PWR, and a reprocessing facility. Appendix C presents release factors for a UO_2 fuel fabrication facility.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 14178

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 13568, 14105

13596 (EGG—2006) **Low-order model of the Loss-of-Fluid Test (LOFT) reactor plant for use in Kalman filter-based optimal estimators.** Tylee, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1980. Contract EY-76-C-07-1570. 111p. Dep. NTIS, PC A06/MF A01.

A low-order, nonlinear model of the Loss-of-Fluid Test (LOFT) reactor plant, for use in Kalman filter estimators, is developed, described, and evaluated. This model consists of 31 differential equations and represents all major subsystems of both the primary and secondary sides of the LOFT plant. Comparisons between model calculations and available LOFT power range testing transients demonstrate the accuracy of the low-order model. The nonlinear model is numerically linearized for future implementation in Kalman filter and optimal control algorithms. The linearized model is shown to be an adequate representation of the nonlinear plant dynamics.

13597 (DOE/TIC—11088) **FFTF driver fuel pellets: typical pellet lot data.** (Kerr-McGee Corp., Oklahoma City, OK (USA)). [nd]. 12p. Dep. NTIS, PC A02/MF A01.

Quality assurance data are presented for FFTF driver fuel pellets.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

13598 (DP—1529) **Solar-powered environmental data collection system.** Randolph, H.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Feb 1980. Contract EY-76-C-09-0001. 18p. Dep. NTIS, PC A02/MF A01.

A solar-powered system consisting of a multipurpose remote data collector, a radio data link, and a data receiving station has been designed to acquire data from various remote areas at the Savannah River Plant. A prototype system has been built to monitor gamma radiation at the plant perimeter. It is operating satisfactorily and will be installed to monitor gamma radiation or other environmental parameters at many remote locations on the plant.

13599 (UNI-SA—77) **Fifteen years experience filtering N reactor gaseous wastes.** Fowler, K.L. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 14 Jan 1980. Contract EY-76-C-06-1857. 19p. (CONF-800211—1). Dep. NTIS, PC A02/MF A01.

From International symposium on management of gaseous wastes from nuclear facilities; Vienna, Austria (18 Feb 1980).

The N Reactor exhaust gas filtering system consists of roughing filters, particulate filters, and charcoal filters, in that order. The basic particulate and charcoal filters consist of 0.46 m^3/s, 60 cm x 60 cm x 30 cm filter canisters installed four canisters wide by ten canisters high in removable filter frames. The roughing filter canisters are about twice as wide and high as the other canisters but fit into similar frames of the same size. There are two side by side frames of each type of filter in each cell for a total design flow of 37 m^3/s. The reactor and primary pipe space air has two cells for normal operation and one cell reserved for the accident case. One cell without roughing filters is used for the first buffer zone air around the reactor.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 13149, 13587, 14451

13600 (EGG/YBR—11-80) **WRRD monthly report for December 1979.** (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1980. Contract EY-76-C-07-1570. 152p. Dep. NTIS, PC A08/MF A01.

Information is presented concerning the Semiscale program; the thermal fuels behavior program; the 3D program; code development and analysis program; and code assessment and applications program.

13601 (ND-R—178(R)) **Whole-core accidents in an LMFBR.** Baker, A.R. (UKAEA Risley Nuclear Power Development Establishment). Nov 1978. 28p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The lecture presents an introduction to the evaluation of whole-core accidents in a liquid-metal cooled fast breeder reactor (LMFBR). These accidents can be sub-divided into two types: transient overpower accidents or transient under-cooling accidents, according as the power or coolant flow is substantially disturbed from normal values. There would only be serious consequences in the event of failure of the reactor's automatic protection system or, for a few less important hypothetical accidents, in the event of sudden and catastrophic failure of a major structure. The treatment of whole-core accidents in safety presentations to responsible authorities is briefly discussed and the possible courses of such accidents are outlined, showing the importance of the Doppler fuel temperature and sodium void coefficients. The calculational methods are described with illustrations from studies with the UK code FRAX. The lecture concludes with brief consideration of the experimental validation of computer codes and the design consequences of whole-core accident studies.

13602 (NUREG—0600) **Investigation into the March 28, 1979 Three Mile Island accident by Office of Inspection and Enforcement (Investigative Report No. 50-320/79-10).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). Jul 1979. 788p. NTIS, PC A99/MF A01.

On March 28, 1979, the Three Mile Island Unit 2 Nuclear Power Plant experienced the most severe accident in U.S. commercial nuclear power plant operating history. This report sets forth the facts concerning the events of the accident determined as a result of an investigation by the NRC Office of Inspection and Enforcement. The IE investigation is limited to two aspects of the accident: (1) Those related operational actions by the licensee during the period from before the initiating event until approximately 8:00 p.m., March 28, when primary coolant flow was re-established by starting a reactor coolant pump, and (2) Those steps taken by the licensee to control the release of radioactive material to the off-site environs, and to implement his emergency plan during the period from the initiation of the event to midnight, March 30. These investigation periods were selected because they include the licensee actions which most significantly affected the accident sequence and its results.

13603 (NUREG/CR—0944) **Hydrodynamics and heat transfer characteristics of liquid pools with bubble agitation.** Blottner, F.G. (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 73p. (SAND—79-1132). Dep. NTIS, PC A04/MF A01.

Estimates are given for the heat transfer coefficients at various interfaces which occur in molten pools on concrete. Previous simulant experiments and correlations are used to determine the hydrodynamic behavior of the pool and heat transfer coefficients for the liquids of interest. Other studies assume a gas film occurs between the concrete and molten pool, but the results of this investigation do not confirm this assumption. The results also indicate the significant influence the very viscous concrete slag has on the properties of the molten pool. Additional experiments and analysis are needed to improve the accuracy of the heat transfer coefficients estimated and to understand the behavior of the concrete slag at the interface between the pool and decomposing concrete.

13604 (NUREG/CR—0984(Vol.10)) **Advanced reactor safety research. Quarterly report, April-June 1979.** (Sandia Labs., Albuquerque, NM (USA)). Nov 1979. Contract EY-76-C-04-0789. 228p. (SAND—79-1597(Vol.10)). Dep. NTIS, PC A11/MF A01.

Progress in LMFBR safety research is summarized for the following study areas: accident energetics; fuel dynamics; core debris behavior; aerosol source normalization; containment analysis; elevated temperature design assessment; LMFBR accident delineation; and test and facility technology.

13605 (NUREG/CR—1035) **Water Reactor Safety Research Division. Quarterly progress report, April 1-June 30, 1979.** Romano, A.J. (comp.). (Brookhaven National Lab., Upton, NY (USA)). Sep 1979. Contract EY-76-C-02-0016. 60p. (BNL-NUREG—51081). Dep. NTIS, PC A04/MF A01.

Information is presented concerning light water reactor thermal/hydraulic development; RAMONA and IRT code modification and evaluation; TRAC evaluation and model improvement; and stress corrosion cracking of PWR steam generator tubing.

13606 (NUREG/CR—1145) **Experiment data report for LOFT nuclear small break experiment L3-1.** Bayless, P.D.; Marlow, J.B.; Averill, R.H. (Idaho National Engineering Lab., Idaho Falls (USA)). Jan 1980. Contract EY-76-C-07-1570. 190p. (EGG—2007). Dep. NTIS, PC A09/MF A01.

Experiment L3-1 was the first small break loss of coolant experiment conducted at the Loss-of-Fluid Test (LOFT) facility with the nuclear core at power. The primary objectives of the experiment were to obtain data for analytical code assessment and to further understand the thermal-hydraulic behavior which occurs during a postulated loss-of-coolant accident in a pressurized water reactor. Other objectives of the experimentd were to determine emergency core cooling system performance, determine any unexpected thresholds or events, determine how effectively typical process instrumentation indicated the true system condition, and define variations in system design or plant operation that could mitigate small break transient phenomena. The experiment successfully accomplished the objectives. The LOFT facility was configured to simulate a postulated loss-of-coolant accident caused by a small break in the primary coolant system cold leg in a commercial pressurized water reactor (~ 1000 MWe).

13607 (NUREG/CR—1200) **Accident delineation and evaluation of the high-temperature gas-cooled reactor system concepts.** Washburn, B.W. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 263p. (LA—8170-MS). Dep. NTIS, PC A12/MF A01.

A methodology of accident delineation and analysis is developed for application to an evaluation of the conceptual design of a high-temperature gas-cooled reactor (HTGR). The conceptual design of the 3000-MW(t) HTGR is studied and probabilities of possible accident sequences are provided. Latent hazards indices are developed for the accident sequences to identify quantitatively the sequences having the greatest potential impact on the public safety.

13608 (NUREG/CR—1201) **Nuclear reactor safety. Quarterly progress report, July 1-September 30, 1979.** Jackson, J.F.; Stevenson, M.G. (comps.). (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 213p. (LA—8171-PR). Dep. NTIS, PC A10/MF A01.

Information is presented concerning TRAC code development for LWR reactors: LWR thermal-hydraulic research; SIMMER code development for LMFBR reactors; HTGR structural evaluation; HTGR phenomena modeling and systems analysis; gas-cooled fast reactor safety experiments; and containment systems and reactor safety analysis.

13609 (NUREG/CR—1229) **Bibliography of reports on research sponsored by the NRC Office of Nuclear Regulatory Research, January-June 1979.** Buchanan, J.R. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 140p. (ORNL/NUREG/NSIC—169). Dep. NTIS, PC A07/MF A01.

A bibliography of 241 reports distributed by contractors of the NRC Office of Nuclear Regulatory Research during the period January through June 1979 is presented along with abstracts from the Nuclear Safety Information Center computer file. The bibliography has been sorted into the subject categories used by NRC to organize the research program. Within the subject categories, the reports are arranged first by contractor organization and then chronologically. A brief description of the NRC research program precedes the bibliography.

13610 (NUREG/CR—1252) **Physics of reactor safety. Quarterly report, July-September 1979.** (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 39p. (ANL—79-98). Dep. NTIS, PC A03/MF A01.

The work in the Applied Physics Division includes reports on reactor-safety research and technical coordination of the RSR safety analysis program by members of the Reactor Safety Appraisals Group, Monte Carlo analysis of safety-related critical assembly experiments by members of the Reactor Computations Group, and planning of safety-related critical experiments by members of the Zero Power Reactor (ZPR) Planning and Experiments Group. Work on reactor core thermal-hydraulics was performed in ANL's Components Technology Division.

13611 (ORNL/CSD/TM—106) **Criticality analyses of disrupted core models of Three Mile Island Unit 2.** Westfall, R.M.; West, J.T.; Whitesides, G.E.; Thomas, J.T. (Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.). Dec 1979. Contract W-7405-ENG-26. 111p. Dep. NTIS, PC A06/MF A01.

Three hypothetical disrupted core models were analyzed for the President's Commission on the Accident at Three Mile Island. Soluble boron in the present configuration was assumed to be 3180 weight parts per million (wppM). Positive reactivity effects due to fuel swelling, fuel slumping, and coolant displacement by ZrO_2 increase the cold, shutdown system multiplication factor from approximately 0.74 to 0.86. The increase in reactivity for the three models can be roughly correlated with a decrease in the borated water-to-fuel volume ratio. Each of the 39,825 pin-lattice locations was modeled explicitly in the Monte Carlo analyses of the reactor core. Parametric studies were performed with one-dimensional discrete-ordinates analyses. The report includes a benchmark critical analysis of the system at hot, zero-power startup, a description of the analytical methods used, and a comprehensive compilation of the data upon which the analytical models were based.

13612 (ORNL/TM—7086) **SPQR: a Monte Carlo reactor kinetics code.** Cramer, S.N.; Dodds, H.L. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 41p. Dep. NTIS, PC A03/MF A01.

The SPQR Monte Carlo code has been developed to analyze fast reactor core accident problems where conventional methods are considered inadequate. The code is based on the adiabatic approximation of the quasi-static method. This initial version contains no automatic material motion or feedback. An existing Monte Carlo code is used to calculate the shape functions and the integral quantities needed in the kinetics module. Several sample problems have been devised and analyzed. Due to the large statistical uncertainty associated with the calculation of reactivity in accident simulations, the results, especially at later times, differ greatly from deterministic methods. It was also found that in large uncoupled systems, the Monte Carlo method has difficulty in handling asymmetric perturbations.

13613 (PNL-SA—7771) **Air velocity profiles near sleeve blockages in an unheated 7 x 7 rod bundle.** Creer, J.M.; Bates, J.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Apr 1979. Contract EY-76-C-06-1830. 13p. (CONF-790808—22). Dep. NTIS, PC A02/MF A01.

From 18. ASME national heat transfer conference; San Diego, CA, USA (Aug 1979).

Local air velocity measurements were obtained with a laser Doppler anemometer near flow blockages in an unheated 7 x 7 rod bundle. Sleeve blockages were positioned on the center nine rods to create an area reduction of 90% in the center four subchannels of the bundle. Experimental results indicated that severe flow disturbances occurred downstream from the blockage cluster but showed only minor flow disturbances upstream from the blockage. Flow reversals were detected downstream from the blockage and persisted for approximately five subchannel hydraulic diameters. The air velocity profiles were in excellent agreement with water velocity data previously obtained at essentially the same Reynolds number. Subchannel average velocity predictions obtained with the COBRA computer program were in good agreement with subchannel average velocities estimated using the measured local velocity data.

13614 (SAND—79-2020C) **Status of the Fire Protection Research (FPR) Program.** Klamerus, L.J. (Sandia Labs., Albuquerque,

NM (USA)). 1979. Contract EY-76-C-04-0789. 8p. (CONF-791118—4). Dep. NTIS, PC A02/MF A01.

From 7. water reactor safety research information meeting; Gaithersburg, MD, USA (5 Nov 1979).

The objective of the Fire Protection Research (FPR) Program under the sponsorship of the Office of Water Reactor Safety Research, USNRC, is to confirm the capability of safety features in use or planned for use in nuclear power plants. This objective is to be achieved by full scale testing and experimental and analytical evaluation of fire phenomenology.

13615 Thermal-reactor safety research in Sweden. Graslund, C.; Hellstrand, E. *Nucl. Saf.;* **21**: No. 1, 1-15(Jan 1980).

Sweden benefits in many ways from the reactor safety research performed in other countries. Its own activity complements this effort, but a certain fraction is oriented toward safety issues that are intimately related to the special design of the ASEA-ATOM boiling-water reactor. Through the availability of the decommissioned Marviken reactor plant, Sweden has been able to play a leading role in integral containment experiments with international participation. Joint efforts with other countries are now devoted to defining new large-scale experiments to be performed in the unique Marviken facility. The largest portion of the safety research program in Sweden is performed by Studsvik Energiteknik AB, but various universities, consultant firms, and research institutes are also involved. In addition, a substantial amount of work is done by the reactor vendor ASEA-ATOM. The overall annual budget is at present between $7 and $8 million, with three governmental authorities as the main financing bodies.

13616 Structural mechanics in reactor technology. Cottrell, W.B. *Nucl. Saf.;* **21**: No. 1, 16-21(Jan 1980).

In a brief article on a big conference-the Fifth International Conference on Structural Mechanics in Reactor Technology (SMIRT-5)-the scope and contents of that conference are identified, and selected highlights are presented. Over 1400 persons attended the week-long meeting, which was held in Berlin, Aug. 13-17, 1979. Over 700 papers were presented in over 100 technical sessions not counting 10 satellite sessions that were held both before and after the conference itself. The plenary talks are summarized and the contributions of Dr. Thomas A. Jaeger, General Chairman of this and all previous SMIRT conferences, are lauded.

13617 German risk study for nuclear power plants. *Nucl. Saf.;* **21**: No. 1, 22-24(Jan 1980).

With this study an attempt was to be made to determine the societal risk of nuclear power plants in the Federal Republic of Germany. For this purpose the frequency of accidents and the consequential health damages were determined. The study was to enable a comparison with the American results by a far-reaching adaptation to the basic assumptions and methods of the Rasmussen Study.

13618 In-pile tests at Karlsruhe of LWR fuel-rod behavior during the heatup phase of a LOCA. Karb, E.H. (Kernforschungszentrum, Karlsruhe, Germany). *Nucl. Saf.;* **21**: No. 1, 26-37(Jan 1980).

In order to investigate the influence of a nuclar environment on the mechanisms of fuel-rod failure, in-pile tests simulating the heatup phase of a loss-of-coolant accident in a pressurized-water reactor are being conducted with irradiated and unirradiated short-length single rods in the FR2 reactor at Kernforschungszentrum karlsruhe (Karlsruhe Nuclear Reasearch Center), Federal Republic of Germany, within the Project Nuclear Safety. With nearly 70% of the scheduled tests completed, no such influences have been found. The in-pile burst and deformation data are in good agreement with results from nonnuclear tests with electrically heated fuel-rod simulators. The phenomenon of pellet disintegration, which has been observed in all tests with previously irradiated rods, needs further investigation.

13619 Technical assessment of disturbance analysis systems. Long, A.B. (Electric Power Research Inst., Palo Alto, CA). *Nucl. Saf.;* **21**: No. 1, 38-50(Jan 1980).

In December 1978, the Electric Power Research Institute sponsored an international specialists workshop on disturbance analysis systems. Since the Three Mile Island incident, the electric-power industry has been evaluating the use of this type of system as a means to improve the operator-process interface during normal and abnormal modes of nuclear plant operation. The functional requirements, justification, technical descriptions, and operation experience with such systems are summarized on the basis of the workshop presentations. Unresolved problems are identified, and ongoing research and development activities in the United States and Europe are briefly reviewed.

13620 Aging techniques and qualified life for safety system components. Weaver, W.W. *Nucl. Saf.;* **21**: No. 1, 51-57(Jan 1980).

Presently, the qualified life objective for Class IE safety system components in nuclear power plants is somewhat of a subjective engineering judgment. When the desired qualified life is ascertained, there are other choices that must be made (which may be influenced by the desired qualified life) such as selecting the aging procedure to use in the qualification process. Adding complexity to the situation is the fact that there are some limitations in aging techniques at the present time. This article presents (1) a discussion of the limitations in aging procedures, (2) the general philosophy of qualification, and (3) a proposed method for specifying a desired qualified life, which uses a probabilistic approach. The probabilistic approach proposed in item 3 can be applied to natural aging programs and eventually to accelerated aging once the present technical difficulties are overcome.

13621 Fire hazards and consequences of fires in nuclear power plants. Talbert, J.H. (National Loss Control Service Corp., Long Grove, IL). *Nucl. Saf.;* **21**: No. 1, 59-67(Jan 1980).

This article briefly describes the fire hazards in nuclear power plants, the potential nuclear-safety-related and economic consequences that can be caused by fires in nuclear power plants, and the use of a fire protection program to prevent unacceptable consequences from occurring.

13622 Review of safety-related events at nuclear power plants as reported in 1978. Scott, R.L.; Gallaher, R.B. *Nucl. Saf.;* **21**: No. 1, 100-109(Jan 1980).

This article reviews the reports of safety-related events at light-water-reactor nuclear power plants submitted in 1978 to the Nuclear Regulatory Commission. The review covers 1239 reports from boiling-water-reactor facilities and 2084 reports from pressurized-water-reactor facilities. Information is presented in tables listing instrument failures, equipment failures, systems involved, causes, deficiencies, and times of occurrence (i.e., refueling, testing, operation, or construction). The tables give the number of reports concerned with each listed item and therefore indicate the frequencies of events and those events which should receive more attention in the form of maintenance and testing to improve plant reliability and safety.

13623 Review of licensee event reports (1976-1978). *Nucl. Saf.;* **21**: No. 1, 110-112(Jan 1980).

Approximately 8700 Licensee Event Reports (LERs) were filed during the 3-year period under review. For purposes of review these reports were classified by components (e.g., valves), systems (e.g., the reactor coolant system), or general categories (e.g., instrumentation and controls), and each class was analyzed separately. A principal objective of the study was to identify those events which have implications for improved reactor safety.

13624 Events resulting in reactor shutdown and their causes. Scott, R.L.; Gallaher, R.B. *Nucl. Saf.;* **21**: No. 1, 112-113(Jan 1980).

The licensee event reports (LERs) from Sept. 1 to Oct. 24, 1979, were reviewed, and those events which involved a reactor shutdown are listed. Both operating research reactors and operating commercial power reactors were considered.

13625 Selected safety-related events reported in October and November 1979. Casto, W.R. *Nucl. Saf.;* **21**: No. 1, 113-115(Jan 1980).

Of the incidents reported during October and November, 1979, two are reviewed because of their uniqueness and general interest: (1) at Rancho Seco the reactor experienced a rapid cooldown and (2) at North Anna 1 high gaseous activity occurred in the auxiliary building.

13626 Sensitivity of emergency core coolant bypass and lower plenum refill to apparatus scale size and lower plenum pressure in a pressurized water reactor. Daly, B.J. (Los Alamos Scientific Lab., NM). *Nucl. Sci. Eng.;* **72**: No. 1, 97-107(Oct 1979).

A series of numerical calculations was performed to study the effect of apparatus scale size on the magnitude and duration of emergency core coolant (ECC) bypass and the time delay for refill of the lower plenum of a pressurized water reactor during a hypothetical loss-of-coolant accident. These results indicate that for certain idealized flow and thermal conditions, flow similarity can be obtained at all scale sizes, but that for more realistic conditions, the effects of apparatus scale size and lower plenum pressure on ECC bypass and lower plenum refill can be large. In particular, the duration of ECC bypass and the time delay for refill appear to be more sensitive to momentum exchange at full scale and high lower plenum pressure than they are at 2/15 scale and low pressure. The sensitivity to mass exchange, ECC subcooling, and wall heat transfer decreases with increasing scale and lower plenum pressure. The effect of introducing steam, rather than air, into the downcomer through the broken ECC injection port when the pressure in the downcomer falls below that in the containment vessel is to decrease the rate of lower plenum refill.

13627 Transient temperature distribution in reactor coolant channel following loss of flow. Ozgu, M.; Chen, J.C. (Bethlehem Steel Corp, Pa). *Lett. Heat Mass Transfer;* **2**: No. 1, 27-36(Jan-Feb 1975).

Analytical solutions to the transient energy equation in a coolant filled channel subsequent to complete flow stoppage were obtained for different end boundary conditions and wall heat fluxes. Sinusoidal and stepwise heat flux distributions along the channel, and constant temperature and zero heat flux end boundary conditions were used. Analytical solutions for variations of temperature with time and axial position were obtained. Sample results were determined for liquid sodium with various values of initial Peclet number. 7 refs.

ENERGY STORAGE

MAGNETIC

REFER ALSO TO CITATION(S) 14560

13628 (LA—8199-PR) **Superconducting magnetic energy storage (SMES) program. Progress report, January 1-December 31, 1979.** Rogers, J.D. (comp.). (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 30p. Dep. NTIS, PC A03/MF A01.

Work is reported on the development of two superconducting magnetic energy storage units. One is a 30-MJ unit for use by the Bonneville Power Administration to stabilize power oscillations on their Pacific ac Intertie, and the second is a 1- to 10-GWh unit for use as a diurnal load-leveling device. Emphasis has been on the stabilizing system. A contract was placed for the fabrication design of the 30-MJ coil design. Orders have been placed for the stabilizing system converter and protective energy dump system, converter transformer, automation of the 4.5 K refrigerator and its installation into a trailer, and a trailer mounted heat-rejection system. A third compressor was added to the refrigeration system, and the refrigerator was tested and accepted. The superconductor for the 30-MJ coil has been received, tested, and found to be satisfactory. Development of the 5-kA superconducting cable is still under way. The reference design for the 1- to 10-GWh diurnal load-leveling unit was completed and has been issued as an eight volume report. The summary and recommendations of the study are included. An alternative use of small superconducting coils for VAR control has been devised.

COMPRESSED GAS

13629 (PNL—3231) **Structural analysis of porous rock reservoirs subjected to conditions of compressed air energy storage.** Friley, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 41p. Dep. NTIS, PC A03/MF A01.

Investigations are described which were performed to assess the structural behavior of porous rock compressed air energy storage (CAES) reservoirs subjected to loading conditions of temperature and pressure felt to be typical of such an operation. Analyses performed addressed not only the nominal or mean reservoir response but also the cyclic response due to charge/discharge operation. The analyses were carried out by assuming various geometrical and material related parameters of a generic site. The objective of this study was to determine the gross response of a generic porous reservoir. The site geometry for this study assumed a cylindrical model 122 m in dia and 57 m high including thicknesses for the cap, porous, and base rock formations. The central portion of the porous zone was assumed to be at a depth of 518 m and at an initial temperature of 20°C. Cyclic loading conditions of compressed air consisted of pressure values in the range of 4.5 to 5.2 MPa and temperature values between 143 and 204°C. Various modes of structural behavior were studied. These response modes were analyzed using loading conditions of temperature and pressure (in the porous zone) corresponding to various operational states during the first year of simulated site operation. The results of the structural analyses performed indicate that the most severely stressed region will likely be in the wellbore vicinity and hence highly dependent on the length of and placement technique utilized in the well production length. Analyses to address this specific areas are currently being pursued.

PUMPED HYDRO

13630 (PB—297131) **Influence of pumped storage flows on thermal stratification in reservoirs. Final report.** Singh, V.; Bajura, R.A.; Schwartz, S.H. (West Virginia Univ., Morgantown (USA). Thermal Hydraulics Lab.). Jan 1979. Contract DI-14-34-0001-6214. 170p. NTIS, PC A08/MF A01.

The characteristics of buoyant submerged horizontal jets which simulate the discharge from power plants were found to be dependent upon the Froude number and the jet and ambient water temperatures. The concentration of salt solutions used to simulate the buoyancy mechanism in some of the tests was observed to alter the mixing characteristics of the jets. A series of tests was conducted to determine the mixing which would occur in two tanks simulating a pumped storage reservoir system after a number of cycles of operation. The mixing in the reservoirs was also simulated using a numerical computational scheme in two dimensions. The numerical predictions were in qualitative agreement with the experimental results.

13631 (PB—297274) **Effect of vertical scale distortion on the temperature field of a thermal-hydraulic model. Research report.** Michelotti, D.P.; Bajura, R.A.; Schwartz, S.H. (Air Pollution Technology, Inc., San Diego, CA (USA)). Oct 1978. Contract DI-14-34-0001-6214. 131p. NTIS, PC A07/MF A01.

The generation of electricity by pumped storage hydroelectric plants to supplement existing thermal power plant facilities for peak energy supply is now used in more than twenty-two locations in the United States. The objectives of this investigation were to determine the effects of a vertical scale distortion on the flow and temperature fields of a hydraulic model of a pumped storage reservoir system. The study considered vertical to horizontal scale ratios of 1:1, 3:1, and 5:1. The model consisted of a submerged hot water jet discharging into an initially cold isothermal reservoir. The jet discharge geometry was patterned after what was considered to be a typical pumped storage outlet. Results are presented for various jet Froude numbers.

13632 (PB—297290) **A numerical simulation for a pumped storage reservoir. Research report.** Faber, J.D.; Bajur, R.A.; Schwartz, S.H. (West Virginia Univ., Morgantown (USA). Thermal Hydraulics Lab.). Oct 1977. Contract DI-14-34-0001-6214. 168p. NTIS, PC A08/MF A01.

Hydroelectric pumped storage power generation is a method of providing electrical energy for peak demand periods now being used by many companies around the world. A computer program was developed to numerically simulate the velocity and temperature fields in an idealized two-dimensional pumped storage reservoir. The reservoir model includes a submerged inlet and a rising upper boundary to simulate rising water surfaces due to inflow. The solution is obtained by solving the energy, vorticity, and stream function equations using various finite differencing techniques. The eddy viscosity and eddy conductivity terms in the equations were considered constant. The nodal spacing and the time step used were found to be the major parameters affecting stability. Results were obtained for a series of test cases with different percentages of the initial volume added.

13633 (PB—297298) **Mixing in rectangular tanks using horizontal jets. Research report.** Taylor, D.L.; Schwartz, S.H.; Bajura, R.A. (West Virginia Univ., Morgantown (USA). Thermal Hydraulics Lab.). Oct 1977. Contract DI-14-34-0001-6214. 130p. NTIS, PC A07/MF A01.

The generation of electricity by pumped storage hydroelectric plants is a concept used to meet peak demands in power supply. The goal of this study is to predict the effect of the discharge and withdrawal flows on the natural thermal stratification of the two reservoirs involved in a pumped storage operation. An experimental program was conducted with two tanks cyclically exchanging water between them. Important flow parameters were varied to determine the effect of each on thermal mixing. Temperature measurement data along with other types of data were reduced and correlations were obtained which can be used to predict the degree of thermal mixing as a function of the relevant dimensionless groups.

THERMAL

REFER ALSO TO CITATION(S) 13386

13634 (DOE/CS/32939—7) **Design method to determine the optimal distribution and amount of insulation for in-ground heat storage tanks.** Williams, G.T.; Attwater, C.R.; Hooper, F.C. (Toronto Univ., Ontario (Canada). Dept. of Mechanical Engineering). May 1979. Contract EY-76-C-02-2939. 5p. (CONF-790541—60). Dep. NTIS, PC A02/MF A01.

From International Solar Energy Society meeting; Atlanta, GA, USA (28 May 1979).

The seasonal sensible heat storage model developed by F.C. Hooper and C.R. Attwater is modified to describe the thermal behaviour of the soil regime surrounding cylindrical, in-ground, heat storage tanks with optimally distributed insulation. The model assumes steady-state heat transfer, and the surrounding soil is considered to be homogeneous and isotropic. Changes in soil thermal properties due to moisture migration, whether driven by thermal or

hydrostatic gradients, are assumed negligible. The optimal distribution is determined using the method of Lagrange multipliers. It is shown that the marginal cost per unit of energy lost and per unit of tank surface area must be the same at all points on the surface of the tank as the condition for minimum total heat loss with a given total investment in insulation. This condition appears to apply for all axisymmetric in-ground tank geometries. For a given volume of insulation, the incremental increase in storage efficiency with an optimal redistribution of the insulation is a function of tank geometry. The problem of determining the optimal total investment in insulation for a given marginal cost of fuel is described and a method of solution is outlined.

13635 (IKE—5-209) **Latent heat thermal energy storage in the temperature range 20 to 80°C.** Abhat, A. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Sep 1978. 44p. Dep. NTIS (US Sales Only), PC A03/MF A01.

After some introductory remarks on the necessity of heat storage - in particular for solar systems and the desired characteristics of a store, the latent heat energy (LTES) store is described as an example. The first chapter discusses the physical fundamentals of LTES (theory of crystallization, phase diagrams, nucleation, technological problem). The second chapter deals with suitable materials, their melting and solidification characteristics, typical heat-up and cooling-down curves, and thermal cycling. The third chapter reports on heat exchangers and their effects on the functioning of the whole system and also discusses experimental results. The appendix contains a comparison between thermal energy storage in water or rocks and latent heat thermal energy storage.

BATTERIES

DESIGN AND DEVELOPMENT

REFER ALSO TO CITATION(S) 13649, 13863

13636 (UCRL—83881) **Weight and volume estimates for aluminum-air batteries designed for electric vehicle applications.** Cooper, J.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 19p. (CONF-790759—3). Dep. NTIS, PC A02/MF A01.

From 1. international workshop on reactive metal-air batteries; Bonn, F.R. Germany (9 Jul 1979).

The weights and volumes of reactants, electrolyte, and hardware components are estimated for an aluminum-air battery designed for a 40-kW (peak), 70-kWh aluminum-air battery. Generalized equations are derived which express battery power and energy content as functions of total anode area, aluminum-anode weight, and discharge current density. Equations are also presented which express total battery weight and volume as linear combinations of the variables, anode area and anode weight. The sizing and placement of battery components within the engine compartment of typical five-passenger vehicles is briefly discussed.

13637 **Battery cell with negative light metal or zinc electrode.** Sauer, H.; Lippold, H.M.; Spahrbier, D. (to Varta A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,746,590/A/. 26 Apr 1979. 19p. (In German).

The invention concerns a battery cell with a negative light metal or zinc electrode and with a positive electrode insulated by an electrically insulating plastic layer from the positive connection made of the chalcolite of a metal with at least 2 values, which discharges in at least two stages, where the discharge voltage of the cell corresponding to the metal chalcolite is suppressed in operation. On discharge in the region below 15 μA, only that voltage appears, without loss of capacity, which corresponds to the potential of the lower or more stable chalcolite, if, according to the invention, the positive electrode with the positive connection is only connected by one electrical contact, whose contact surface with the higher value chalcolite electrode is so small that, at a current consumption of less than 15 μA, the reduction of the chalcolite connection determining the lower discharge voltage takes place more quickly to a chalcolite-poor phase or to the metal at the contact than the oxidation of this metal or this chalcolite-poor phase to a higher value metal chalcolite to which these are connected by the electrolyte. The electrode combinations zinc/silver oxide, lithium/bismuth oxide and lithium/lead oxide are included in the claims.

13638 **Gas-tight sealed galvanic cell with plastic casing.** Gnida, B.; Simon, G.; Buder, E.; Schwartz, H.J. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,742,869/A/. 12 Apr 1979. 11p. (In German).

The invention concerns a gas-tight sealed galvanic cell with plastic casing and closed with plastic-composite contact plates which are connected to the electrodes via current conductors, as well as a method to fabricate this kind of cell. A flat gas-tight galvanic cell with plastic casing surrounding it whose dimensions remain unchanged with the developing pressure of gases inside the cell due to possible overloading or continuous loading is achieved by the following constructive measures: The electrodes and separators are arranged in the form of a plate packet surrounded by a casing consisting of floor and lid. The lid has two contact discs in the form of pole passages. The casing flower has a peg protruding into the plate packet designed with appropriate openings. The peak of the casing peg is welded to the casing lid.

13639 **Voltaic cell.** Robinson, G.; Jones, I.W. (to Electricity Council, London (UK); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,400,202/B/. 30 Nov 1978. 8p. (In German).

The invention consists of a cylindrical sodium-sulfur secondary cell so designed that it can be operated even over longer periods in a non-vertical position.

13640 **Galvanic cell, containing an electrically conducting cylindrical beaker and a spirally wound electrode system within the beaker.** Russell, E.T.; Greaser, S.H. (to Union Carbide Corp., New York (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,452,948/C/. 14 Sep 1978. 6p. (In German).

The spirally wound electrode system consisting of two band-formed electrodes of different polarity and at least two spirally wound separators can be united together in a complete cell without damaging, if one of the separators covers the outer circumference of the winding and the outside separator has at least one opening which gives access to the outer electrode in such a way that this one touches the inside wall of the beaker that acts as a second current collector. The invention is advantageous above all for nickel-cadmium cells, in which the inside electrode is the positive one.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 13650, 13654, 13862, 13865

13641 **Method for the charging of gastight batteries.** Koethe, H.K.; Strasen, G. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,636,034/A/. 16 Feb 1978. 16p. (In German).

Gastight batteries are charged up to the preplanned cut-off voltage with a current intensity which is directly proportional to the battery temperature. The charging cut-off voltage does not depend on temperature.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 13724

13642 (AD-A—063108) **The behavior of molybdenum trioxide electrodes in nonaqueous electrolytes. Technical report.** Hunger, H.F.; Ellison, J.E. (Army Electronics Research and Development Command, Fort Monmouth, NJ (USA). Electronics Technology/Devices Lab.). Oct 1978. 20p. NTIS, PC A02/MF A01.

Experimental work with molybdenum trioxide cathodes in organic electrolytes was aimed at increasing the cathodic rate capability of the electrodes. Coulombic analysis of cycling experiments suggests a high coulombic efficiency up to 1.5 F per molybdenum atom. The cathode kinetics is characterized by a fast electron transfer step followed by a slow diffusion step which becomes rate determining at practical current densities. Electrolyte solvent optimization led to a considerable increase in rate capability up to 25 mA/sq cm.

13643 **Method for the removing of nitrate residues from the active mass of positive electrodes.** Winsel, A. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,631,839/A/. 19 Jan 1978. 7p. (In German).

The nickel nitrate residues remaining in the electrode paste during the production of positive electrodes of nickel-cadmium batteries can be removed, as the invention proposes, by putting a negative potential in the range of the nickel potential on to the positive electrode at the beginning of the preforming by pole-changing. The nitrate is reduced to ammonia and escapes as a gas. Afterwards the electrode-paste is formed by putting a positive potential which leads to a deposition of oxygen.

13644 (N—79-17330) **Feasibility study for a secondary Na/S battery. Final report, 1 October 1977 - 30 September 1978.** Abraham, K.M.; Schiff, R.; Brummer, S.B. (EIC, Inc., Newton, MA (USA)). Jan 1979. Contract NAS3-21028. 65p. NTIS, PC A04/MF A01.

The feasibility of a moderate temperature Na battery was studied. This battery is to operate at a temperature in the range of 100-150 C. Two kinds of cathode were investigated: (1) a soluble S cathode consisting of a solution of Na^2Sn in an organic solvent and

(2) an insoluble S cathode consisting of a transition metal dichalcogenide in contact with a Na+ ion conducting electrolyte. Four amide solvents, dimethyl acetamide, diethyl acetamide, N-methyl acetamide and acetamide, were investigated as possible solvents for the soluble S cathode. Results of stability and electrochemical studies using these solvents are presented. The dialkyl substituted amides were found to be superior. Although the alcohol 1,3-cyclohexanediol was found to be stable in the presence of Na^2Sn at 130 C, its Na^2Sn solutions did not appear to have suitable electrochemical properties.

13645 Method to insert contour rods into double tissue for the production of tube pockets for accumulator electrodes. Bannach, J. (to Varta A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,406,357/C/. 5 Jul 1979. 5p. (In German).

The device contains storage containers for the contour rods some of which are led into the double tissue opened by the straddling device. It is claimed that the storage containers consist of at least two funnels next to each other and connected by an opening and that the second funnel should have a device for changing its free cross section in its outflowing area.

13646 Oxygen electrode of hydrophobic activated carbon for alkaline galvanic batteries. Henssen, H.F. (to Deutsches Patentamt, Muenchen (Germany, F.R.); Societe des Accumulateurs Fixes et de Traction, 93 - Romainville (France)). German(FRG) Patent 2,345,473/C/. 3 May 1979. 4p. (In German).

The invention concerns an oxygen electrode for alkaline galvanic elements of loosely pressed, hydrophobic activated carbon with a specific surface of generally over 500 m^2/g which is kept in a container with an air-permeable cover of hydrophobic plastics. What is claimed is a three-layer, porous body containing the electrolyte which encloses the cylindrical air cathode. The side facing the activated carbon of the air electrode consists of porous silver and the side facing the anode, of a separator of sulfite cellulose. Between these two layers, there is a porous layer of nonwoven polyamide, polyethylene, or polypropylene tissue. Further claims concern constructional measures to improve storability and leak-tightness.

13647 Oxygen dissolution and deposition electrode for metal/air cells. Groeppel, D.; Siemsen, G. (to Deutsches Patentamt, Muenchen (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.); Siemens A.G., Berlin (Germany, F.R.)). German(FRG) Patent 2,404,444/C/. 29 Mar 1979. 10p. (In German).

The invention concerns a porous oxygen dissolution and deposition electrode for metal/air cells with a hydrophilic nickel layer for oxygen deposition on the electrolyte side, a hydrophobic plastic layer on the gas side, and a hydrophobic coal layer in between that has an internal metallic structure and dissolves oxygen. For a satisfactory mechanical stability of the hybride electrode, the metallic structure contained in the carbon layer is firmly connected with the nickel layer on the electrolyte side. On the gas side, at least parts of the metallic structure project out from the carbon layer into the plastic layer. The plastic layer also contains a metallic structure which is firmly connected with the metallic structure of the coal layer projecting into the plastic layer.

13648 Electric accumulator with gas-operated electrolyte. Winsel, A. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Inst. fuer Wirtschaftsforschung, Berlin (Germany, F.R.). Abt. Bergbau und Energie). German(FRG) Patent 2,741,933/A/. 29 Mar 1979. 7p. (In German).

A systematic electrolyte circulation with uniform heat and concentration distribution is achieved according to the invention in that the electrode plate block rests with three of its sides firmly against the accumulator casing and that there is an electrolyte channel between the 4th side and the casing wall which contains a gas bubble source for the directed movement of the electrolyte. The gas bubble source can be controlled by a concentration gauge and be either connected to a pressure gas line or to an electrolysis cell.

13649 Electrochemical secondary cell with a negative zinc electrode. Hoekje, H.H.; Dietz, P.L. (to PPG Industries, Inc., Pittsburgh, PA (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,444,147/C/. 15 Feb 1979. 8p. (In German).

The claim deals with a zinc halogen secondary cell with a positive electrode that does not get used up and an electrochemically reversible zinc halide electrolyte. An electrolyte-nonpenetrable carrier of silicon with an electrically conducting layer of electrocatalysts on its surface is claimed for the positive electrode. The claimed electrolyte is an aqueous solution of zinc chloride or zinc bromide.

13650 Method to store at least one metal/oxygen cell prior to use. Tapping, K.G.; Jones, P.C. (to Deutsches Patentamt, Muenchen (Germany, F.R.); Ever Ready Co. (Hoddrings) Ltd., London (UK)). German(FRG) Patent 2,108,847/C/. 8 Feb 1979. 6p. (In German).

The invention concerns a container to store zinc-air cells filled with alkali brine. The container is totally impermeable to steam and oxygen; however it is permeable to hydrogen either via a back valve or via a palladium membrane. The cladding of the container consists of a coated foil of polyethylene and polyethylene terephthalate.

13651 Device for filling tubular electrode plates for lead batteries. Barth, P.U.; Kubis, C.; Weber, H.J.; Wiepen, R. (to Varta A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,732,767/A/. 1 Feb 1979. 8p. (In German).

The device applies the vibration principle and according to the invention it uses a filling cassette for accommodating tubular electrode plates. The filling cassette has a filling funnel and is suspended with its vibration drive by springs. The vibration drive consists either of two out-of-balance motors, which are rigidly connected to the lower frame of the cassette, and have opposite directions of rotation, or of one out-of-balance motor, which is connected to a joint below the frame of the cassette.

13652 Arrangement for the accumulation of electrical energy. Hacha, T.H. (to Standard Oil Co., Cleveland, OH (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 1,921,611/B. 26 Oct 1978. 5p. (In German).

The invention deals with a current arrester for higher temperature batteries, which work with molten salt as electrolytes. The current arrester consists of a flexible graphite lamina or a flexible graphite band with anisotropic properties for the electrical resistivity: it is embedded in the electrode consisting of activated carbon.

13653 Method to coat plastic closure strips on positive tube plates of lead accumulators. Wiepen, R. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,713,167/A/. 4 Oct 1978. 7p. (In German).

The lead cores protruding from the bottom side of the tube electrode plates filled with active mass are centered and aligned. A plastic closure strip having boreholes with centering cones is pushed onto the lead cores and ultrasonically firmly fixed to their ends. The plastic material for the closure strips is preferably polyethylene or polypropylene. Every thermoplastic plastic that can be ultrasonically welded and that meets with the chemical, thermal and mechanical requirements in the battery is bacially suitable.

13654 Gastight battery. Seiger, H.N. (to SAFT American, Inc., Valdosta, GA (USA); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 1,671,775/C/. 28 Sep 1978. 11p. (In German).

The invention concerns gastight nickel- and silver-cadmium dry cell batteries which are charged by solar cell charging devices and which have a current-dependent control device in their electrochemical systems for this purpose. To avoid damage due to overloads the control device according to the invention is designed so that the switching device for switching off the charging process is actuated at a control current which reaches a trip value, which corresponds to a slightly lower value than the charging current for the fully charged condition of the battery. The control device should have an impedance which corresponds to a voltage between the negative electrode and the control electrode of not more than 40% of the voltage of the negative electrode when gassing stops at the negative electrode after charging. The trip value of the control current is achieved when the battery has reached between 90 and 97% of full charge.

13655 Galvanic battery, in particular, alkaline battery. Winsel, A. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,636,230/A/. 16 Feb 1978. 7p. (In German).

The sealing problem of gastight packed nickel-cadmium batteries is solved as proposed by the invention by covering the metal surface of the housing part connected with the negative electrode on the area where the seals lie with a passive oxide coating which cannot be reduced by the potential of the negative electrode. As passive oxides nickel and titanium oxides are proposed. These are produced by tempering in an oxygen atmosphere.

13656 Electric battery. Steffens, K. (to Varta Batterie A.G., Hannover (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,635,472/A/. 9 Feb 1978. 8p. (In German).

In Battery units, as they are used in battery driven cars for example, damaging temperature gradients can appear induced by external temperature variations and/or strong load variations. The invention describes an arrangement for the uniform tempering of the electrolytes of all batteries of a complete unit.

ENERGY MANAGEMENT AND POLICY

REFER ALSO TO CITATION(S) 14610

13657 (DOE/EIA—0008/2(79)) **Energy information quarterly report: second quarter 1979. Report to Congress.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1979. 55p. (NTISUB/E—027-02). GPO $2.50.

Summary data are presented for US production, consumption, and net imports of energy for the second quarter of 1979. Extensive data are also presented on resource development, coal, crude oil and natural gas proved reserves estimates, natural gas, petroleum, nuclear power, and electric power generation.

13658 (DOE/TIC—11092) **Energy emergency handbook.** (Department of Energy, Washington, DC (USA). Economic Regulatory Administration). 1979. 700p. Dep. NTIS, PC A99/MF A01.

The handbook is designed to aid those needful of making decisions during a short-term energy emergency, those in private industry and state and local government. It identifies selected state and Federal measures available to mitigate the impact of an energy emergency, and provides a comprehensive energy emergency communications directory. In the case of state remedial actions, particular emphasis has been placed on typical implementation procedures and likely impacts. The discussions of Federal actions focus on initiation and implementation procedures. The directory is designed to facilitate communications of all types (telephone, Telex, TWX, or facsimile) among key energy-emergency officials in the Federal and state governments.

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 13051, 13714, 13732, 13760, 13763, 13823

13659 (NTIS/PS—79/0337) **Forecasts of energy technology (citations from the International Aerospace Abstracts data base). Report for 1974—December 1978.** Zollars, G.F. (New Mexico Univ., Albuquerque (USA). Technology Application Center). Apr 1979. 47p. NTIS PCN01/MF N01.

The cited articles from worldwide literature concern forecasts of the development of energy technology. Stressed are forecasts relating to new energy sources such as hydrogen-based energy, solar energy conversion and to nuclear energy and coal utilization. Economic analyses of various energy conversion techniques are included. (Contains 183 citations)

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 13063, 13669, 13670, 13682, 13683, 13686, 13698, 13742, 14580

13660 (CONF-780754—, pp 107-114) **Analysis of federal incentives used to stimulate energy production.** 1978.

From Solar Northwest conference; Portland, OR, USA (14 Jul 1978).

Past and present federal incentives to production of various energy sources an analyzed. The following are included: generic incentives; nuclear, hydro, coal, oil, and natural gas incentives; and insights into potential incentives for solar policy. (MHR)

13661 (COO—4954-1(Vol.3)) **Energy Economic Data Base (EEDB) program: phase I. Final report and initial update.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Dec 1979. Contract EN-78-C-02-4954. 210p. Dep. NTIS, PC A10/MF A01.

Volume I describes the EEDB and presents some pertinent update material. The initial appendices make up Volume II in which descriptions of the Standard Hypothetical Middletown Sites for nuclear power plants and coal-fired power plants are presented. Additional data in appendices in Volume II include information on NUS Corporation fuel-cycle work; inflation-free fixed charge rates; capital cost update procedure; and Combustion Engineering, Inc. LMFBR NPGS Target nuclear steam supply system. This Volume, III, contains additional appendices entitled: Practical Target Economics for the Liquid Metal Fast Breeder Reactor Nuclear Power Generating Station; Air-Quality Impact Analysis for Determination of the Acceptability of Qualified High- and Low-sulfur Coal-Fired Facility Designs for the Hypothetical Middletown Site; Synthetic Power Plant Fuels by the Solvent Refined Coal Process; Inflation-Free Fuel Cycle Costs for Throwaway and Recycle Cases; Inflated (6%) Fuel Cycle costs for Throwaway and Recycle Cases. Inflated (7%) Fuel Costs for Throwaway and Recycle Cases; Inflated (8%) Fuel Cycle Costs for Throwaway and Recycle Cases; Fuel Costing Methodology; and Bred-Fuel Scenarios.

13662 (ORAU/IEA—79-23(M)) **France: estimates of future energy/GDP relationships.** Allen, E.L. (Oak Ridge Associated Universities, Inc., Washington, DC (USA). Inst. for Energy Analysis). Dec 1979. Contract EY-76-C-05-0033. 67p. Dep. NTIS, PC A04/MF A01.

Compared with other OECD nations, France's postwar economic growth has been above average. Gross domestic product (GDP) grew at an annual rate of 4.1% in the 1970s. A high rate of new investment (fixed, nonresidential investment) was achieved during these years to bolster productivity gains. Since France depends primarily on imports for its energy supplies, energy use has become relatively efficient. Government policy emphasizes energy savings in all sectors; the E/GDP ratio increased only slightly to 1973 and thereafter fell sharply. As to the future, economic growth, as measured by GDP, is expected to moderate over the balance of this century, to a level of 2.8% annually by the 1995-2000 period. Labor force growth will decline because of decreased domestic fertility and the more restrictive immigration policy. In addition, the length of the workweek, which has remained relatively high, is expected to follow the declining trend already evident in other OECD countries. Future energy consumption is projected to rise from 6.61 Btu x 10^{15} in 1976 to 9.85 Btu x 10^{15} in 2000.

13663 (PB—292510) **Construction worker profile. community report--Forsyth and Colstrip, Montana.** Chalmers, J.A.; Glazner, J. (Mountain West Research, Inc., Billings, MT (USA)). Dec 1975. Contract OWRC-10570042. 93p. NTIS, PC A05/MF A01.

Colstrip and Forsyth, Montana are two of the currently affected communities included in the study to help us learn something of the effects which large-scale construction projects have on small communities. The findings of the Project Survey, which was conducted at the Colstrip power plant, along with the findings of the Household Survey, conducted in both Colstrip and Forsyth, are presented. The Household Survey findings for both towns are included because both towns were affected by the construction of the Colstrip electrical generating plant, and it was assumed that anyone interested in data for one town would be interested in those for the other.

13664 (PB—292511) **Contruction worker profile. community report--Center, North Dakota.** Chalmers, J.A.; Glazner, J. (Mountain West Research, Inc., Billings, MT (USA)). Dec 1975. Contract OWRC-10570042. 99p. NTIS, PC A05/MF A01.

Center, North Dakota is one of the currently affected communities included in the study to help us learn something of the effects which large-scale construction projects have on small communities. The findings of the Project Survey, which was conducted at the Milton R. Young and Leland Olds Power plants, along with the findings of the Household Survey and the Community Survey, are presented.

13665 (PNL—3091) **Estimation of the social costs of natural gas.** Nieves, L.A.; Lemon, J.R. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 64p. Dep. NTIS, PC A04/MF A01.

This study determines the extent to which it is possible to develop monetary estimates of the marginal social cost of fuels, using natural gas to test a methodology that could be applied to other fuels. This requires review of previous estimates of both market and nonmarket costs to the extent that such are available. For some components of social cost, calculation of estimates from secondary data is required. The feasibility of using these estimates to develop marginal social-cost estimates for the country and for states or regions must then be evaluated. In order to develop estimates of marginal social cost for use in determining minimum life-cycle costs of building space conditioning, economic theory is used to develop a conceptual model of the market cost of fuel extraction and conversion. Then, estimation methodologies for each component of nonmarket costs are examined to assess the applicability and validity of each methodology. On the basis of this analysis, empirical estimates of both market and nonmarket components of social cost are aggregated to calculate a social-cost estimate for natural gas. 38 references.

13666 **National coal utilization assessment: some potential impacts in the south.** Davis, R.M.; Honea, R.B.; Dobson, J.E.; Berry, L.G. (Oak Ridge National Lab., TN). pp 15-20 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

The National Coal Utilization Assessment is a two-year program sponsored by the Assistant Administrator for Environment and Safety, Department of Energy, to assess the potential environmental,

social, and economic effects of coal development and use at the national and regional level. ORNL is one of six national laboratories participating in the program and is conducting the assessment in the 12-state southern region. The assessment is designed to analyze national as well as regional distributional effects of an energy policy of increased coal use. The analysis is based on a recent-trends national energy scenario which is disaggregated to estimate regional energy demands for the period 1975 to 2020. Additional power plants are sited at the county level wherever forecasted generation capacity is adequate to meet forecasted regional demand. Future synfuel plants and coal mining activity are also located. These coal development and use patterns were used to conduct an analysis of the potential water resource and socioeconomic effects that may be experienced in the southern region. The potential impacts identified in the analysis are significant, particularly in the 1990 to 2020 time period. Careful planning as well as the selection of alternative technologies may be required to reduce or mitigate these impacts.

13667 Social impacts of energy development. Johnson, S.; Blome, D.A. (Univ. of Kentucky, Louisville). pp 105-108 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

The social impact of energy source development is discussed with focus on the benefits and costs associated with these developments. Costs and benefits vary by one's location in the country, socio-economic status, conservation ethic, and by one's lifestyle with regard to energy usage. The impacts in Kentucky are specifically noted.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 13689, 13822, 14126, 14215, 14216, 14217, 14293

13668 (PB—295508) **MERL report of progress, 1978. Progress report.** (Environmental Protection Agency, Cincinnati, OH (USA). Municipal Environmental Research Lab.). Apr 1979. 86p. NTIS PC A05/MF A01.

The Municipal Environmental Research Laboratory is EPA's research component for the development of technology, systems and processes to combat environmental pollutants that trouble our communities and municipalities. The report discusses the development and demonstration of cost-effective pollution control methods in the areas of sewage and wastewaters, solid and hazardous wastes, public drinking water supplies, and urban systems management. Although some of its content is technical, the report is written to be informative for a wide management audience in the business and industry, education, and government, and others who are interested in the environment and related fields.

13669 (PB—298074) **Energy from the west: Policy analysis report. Final report Jul 75-Feb 79.** White, I.L.; Chartock, M.A.; Leonard, R.L.; Ballard, S.C.; Calzonetti, F.J. (Oklahoma Univ., Norman (USA). Science and Public Policy Program). Mar 1979. Contract EPA-68-01-1916. 857p. NTIS, PC A99/MF A01.

The study examines the development of six energy resources (coal, geothermal, natural gas, oil, oil shale, and uranium) in eight western states (Arizona, Colorado, Montana, New Mexico, North Dakota, South Dakota, Utah, and Wyoming) during the period from the present to the year 2000. Nine major problem and issue categories are analyzed: water quality, water availability, air quality, land use and reclamation housing, growth management, capital availability, transportation, and energy facility siting. The final chapter discusses policy responses available to policy makers at various levels of government, in Indian Trades, and in the private sector.

13670 Plant-siting considerations. Halpern, J.A. (Dames and Moore, Cranford, NJ). pp 109-113 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

Three basic interrelated considerations important behind the selection of a site for an energy facility that can be licensed in a cost-effective manner are environmental, safety, and engineering. Different methods of doing site selection are cited. The constraint overlay method is emphasized. Maps are developed for the consideration which defines the effect of particular issues (location of water, where the eagles are, marshes are identified, etc.). It is then necessary to combine the issues to allow determination of potential site areas. The method using statistics and the Delphi approach is discussed. (MCW)

13671 Dose-response and standard setting. Weinberg, A.M. (Oak Ridge Associated Universities, TN). *Environ. Int.;* **1**: No. 6, 285-287(1978).

From Conference on environmental biological hazards and competing risks; Oak Ridge, TN, USA (7 Sep 1977).

The writer discusses the methodology and background assumptions used in the setting of standards for human exposure to environmental hazards, specifically radiation. He goes on to present argument for an alternative methodology and philosophy for the setting of standards based upon natural background levels of exposure. (ACR)

13672 Practical societal problem of pollution and public health as the source of a variety of problems regarding chance mechanisms operating in living organisms. Neyman, J. (Univ. of California, Berkeley). *Environ. Int.;* **1**: No. 6, 293-302(1978).

From Conference on environmental biological hazards and competing risks; Oak Ridge, TN, USA (7 Sep 1977).

The essence of the societal problem which justifies the expenditure of large sums on studies of pollution and health is illustrated by three figures included in this paper. The fist two of these figures illustrate the contemporary publicity favoring the two competing energy-producing technologies, the nuclear and the conventional fossil-burning technologies. The very existence of this costly publicity demonstrates that the decisions affecting public health are now frequently made without due regard to the relevant scientific findings. The third figure illustrates the most laudable effort of the Environmental Protection Agency to establish a relationship between hoped-for decreases in mortality and the dollar cost of removing from the environment any one of the several investigated pollutants, e.g., particulates, krypton-85, tritium, etc. The subsequent parts of this presentation tend to document the fact that the reliability of the EPA chart published in 1973 is illusory. The same applies to the large number of other official publications, including those of the National Academy of Sciences. The results of more modern studies brought to the fore a variety of biological chance mechanisms, such as competing risks, dose-rate effects, synergisms, etc., which make the problem attacked by EPA much more difficult than was originally anticipated. The basic research, combining the laboratory experimentation on animals and theoretical considerations, results in a better understanding of a variety of phenomena. However, this better understanding seems to imply that the solution of the practical societal problem requires a large multipollutant and multilocality epidemiological study.

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 13689, 13690, 13806, 13821

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 13074, 13075, 13076, 13077, 13078, 13213, 13695, 13718, 13864

13673 (DOE/PE/6089—1) **Study of energy R and D in the private sector.** (Industrial Research Inst. Research Corp., St. Louis, MO (USA)). Jan 1980. Contract EX-77-C-01-6089. 198p. Dep. NTIS, PC A09/MF A01.

This study supplies DOE with information pertinent to the formulation of realistic national energy research policies and facilitates cooperation between government and business in the development and commercialization of new and improved energy technologies. The study gathered information on the amount of energy-related research and development that private companies are doing, types of energy-related programs they report, and their perceptions about appropriate areas for government support. Mail questionnaires obtained data on the amount of corporate research funding in specific energy-related technology areas and the interviews gathered information on corporate energy strategies, major commercial activities, and specific research plans in four major areas - conservation, supply, energy production and transmission, and new products. (MCW)

13674 (OTA-R—70) **Role of demonstrations in Federal R & D policy.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Jul 1978. 75p. GPO.

Demonstrations are frequently used in areas, such as energy, where there is controversy concerning what constitutes desirable and timely innovations. To effectively evaluate proposed and ongoing demonstrations in such areas. Congress must be able to develop a set of realistic expectations for a demonstration's outcome. In order to provide this capability, the present report develops: a

perspective that permits analysis of demonstrations in many policy contexts; and guidelines to aid the evaluation of individual proposals for demonstration projects. The perspective and guidelines are derived from analyzing the lessons learned in both social and hardware demonstrations.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 13126, 13545, 13569, 13572, 13583, 13661, 14126

13675 (PNL—2997) **Comparative analysis of print media coverage of nuclear power and coal issues.** Nealey, S.M.; Rankin, W.L.; Montano, D.E. (Battelle Human Affairs Research Center, Seattle, WA (USA)). Oct 1978. Contract EW-78-C-06-1076. 29p. Dep. NTIS, PC A03/MF A01.

Nuclear power has been a more important topic than has coal for the print media, and has received somewhat different treatment. Compared to the number of coal articles, almost twice as many nuclear power articles were printed from 1972 through 1976. Also, while the number of nuclear power articles increased somewhat steadily from 1972 through 1976, the number of coal articles peaked in 1974 and has decreased since. The newspapers sampled gave more prominence to nuclear articles in terms of article type and article location. Also, nuclear articles were more often issue-oriented compared to coal articles. Coal articles were most often about coal mining, labor force concerns, and regulations controls. Nuclear power articles, on the other hand, were mostly about reactor operation. The main issues discussed in the coal articles pertained most to political decisions affecting coal use, to strikes, and to health and safety. The main nuclear issues pertained to economics, to health and safety, and to political decisions. Newspapers handled nuclear power articles in a more polarized manner compared to coal articles which were handled in a more neutral manner. Magazine articles were significantly more antinuclear than anticoal. Some qualifications about these conclusions are included. (LTN)

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 13020

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 12943, 13034, 13807, 13812, 13813, 13814, 13815, 13816, 13817, 13819, 13820

13676 (ORNL/SUB—79/13521/1) **Financial considerations affecting implementation of a large multiparty cogeneration project.** (Kidder, Peabody and Co., Inc., New York (USA)). Apr 1979. Contract W-7405-ENG-26. 84p. Dep. NTIS, PC A05/MF A01.

The report identifies problems inhibiting large scale multiparty cogeneration development and suggests means to reconcile the parties' differing interests. The analytical approach adopted for structuring ownership arrangements for a cogeneration project, once engineering studies confirm that the requisite technical advantages exist, is to attempt to resolve three specific issues: (1) identification of the potential participants (industrial customers, the electric utility serving the area, equipment vendors and erectors, design and engineering firms, fuel suppliers and transporters, passive investors, governmental interests, insurance carriers, and others); (2) selection of one or more of the three principal roles which each participant may play: (a) purchaser of project output, (b) provider of other commitments to support financing of the project, and (c) investor in the project; and (3) as to those participants taking an ownership role in the project, deciding whether one participant will act as sole owner or, if joint ownership is selected, deciding which of two structural formats they prefer: (a) an undivided interest approach in which each participant is responsible for and bears the full burden of providing its proportionate share of funding for the project; or (b) a project-entity approach in which each participant owns an interest in a newly organized entity which in turn owns project assets, thereby making the funding of the project the common responsibility of all of the participants.

CONSERVATION

REFER ALSO TO CITATION(S) 13730, 13733, 13735, 13742, 13757, 13763, 13773, 13797, 13810, 13824

13677 (CONS—4172-T1) **Illinois energy conservation plan report: 1979 revision.** (Illinois Inst. of Natural Resources, Springfield (USA)). Feb 1979. Contract EU-78-G-01-4172. 382p. (ILLDOE—79/02). Dep. NTIS, PC A17/MF A01.

In response to Energy Policy and this Conservation Act (PL 94-163) and Energy Conservation and Production Act (PL 94-385), this paper describes the activities to be undertaken by Illinois to meet the mandatory requirements of the Acts and to carry out other activities to encourage energy conservation by energy-consuming sectors in the state. Programs reach the residential, commercial/industrial, agricultural, educational, transportation, and government sectors. The overall goal of the program is to reduce projected energy consumption in 1980 by 5% through information and educational activities.

13678 (PB—296969) **Energy-saving strategies for federal procurement.** (Capital District Regional Planning Commission, Albany, NY (USA)). 19 Jun 1979. 14p. NTIS, PC A02/MF A01.

This report evaluates Federal energy conservation measures and reviews what Federal agencies have done to develop and implement procurement techniques which result in reduced energy consumption.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 13114, 13743, 13754

13679 (DOE/EIA—0035/11(78)) **Monthly Energy Review, November 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Nov 1978. 104p. Dep. NTIS, PC A06/MF A01.

Domestic consumption of energy during August increased 3.2% over August of 1977, and 2% over July's consumption. Domestic production of energy during August increased by 2.5% from July's production compared to a 4.1% increase from July to August of 1977. Additionally, extensive data are compiled on crude oil, total refined petroleum products, total petroleum imports, motor gasoline, jet fuel, distillate fuel oil, residual fuel oil, natural gas plant liquids, US petroleum supply and demand, natural gas, oil and gas exploration and development, bituminous and anthracite coal, lignite, electric utilities, nuclear power, and prices of these commodities. Global data for petroleum consumption and crude oil production are included. (MCW)

13680 (DOE/EIA—0035/12(78)) **Monthly Energy Review, December 1978.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Dec 1978. 114p. (NTISUB/D/127—012). Dep. NTIS, PC A06/MF A01.

Domestic consumption of energy during September decreased 7% from August's consumption and 0.7% from September 1977. Domestic production of energy during September 1978 decreased 6.8% from August's production and 5.8% from September of 1977. Additionally, extensive data are compiled on crude oil, total refined petroleum products, total petroleum imports, motor gasoline, jet fuel, distillate fuel oil, residual fuel oil, natural gas plant liquids, US petroleum supply and demand, natural gas, oil and gas exploration and development, bituminous and anthracite coal, lignite, electric utilities, nuclear power, and prices of these commodities. Global data for petroleum consumption and crude oil production are included. (MCW)

13681 (DOE/EIA—0102/26) **State earnings analysis for the administrator's annual report. Analysis Memorandum AM/IA/78-03.** (Department of Energy, Washington, DC (USA). Energy Information Administration). May 1978. 50p. Dep. NTIS, PC A03/MF A01.

The 1978 EIA Annual Report to Congress, Volume II, considers a series of energy projections that incorporate different assumptions about energy resource availability, economic growth, and the price of imported oil. A version of the Regional Earnings Impact System (REIS) is used to estimate the 1985 State earnings associated with five of those energy projections. The projections are: high energy resources and high economic growth; low energy resources and high economic growth; mid-level energy resources and economic growth; high energy resources and low economic growth; and low energy resources and low economic growth. The above series assume a $13.00 constant real price for imported oil.

13682 (ORAU/IEA—79-20(M)) **Italy: estimates of future energy/GDP relationships.** Davison, C.; Allen, E.L. (Oak Ridge Associated Universities, Inc., Washington, DC (USA). Inst. for Energy Analysis). Dec 1979. Contract EY-76-C-05-0033. 61p. Dep. NTIS, PC A04/MF A01.

The Italian economy has experienced very rapid growth since World War II, accompanied by a sharp increase in the consumption of energy, the growth of which has been more rapid than the development of the economy. For the period 1960-76, energy consumption grew an average of 6.7% annually, compared with an

annual growth rate of 4.6% for gross domestic product. The ratio of energy use per unit of GNP increased in every year from the early 1960s until the oil price rise in 1973 and after a brief pause then began to rise again. By 1975, when the E/GDP ratios of other industrialized OECD countries were hitting record lows, Italy's ratio was at an all-time high. This increasing E/GDP ratio has been largely the result of Italy's very rapid industrial expansion and its attempt to catch up with the stage of industrial maturity already achieved in other developed countries. It is anticipated that the E/GDP ratio will decline in the future as Italy's industrial expansion slows down. Increased efficiencies will flow from the application of new technologies and replacement of old plants. Pressure from higher oil prices and structural changes in Italian society also will dampen down the E/GDP ratio, as it has in other industrialized countries. GDP growth will slacken as the fertility rate continues its downward trend and the average workweek fails. We estimate that by the year 2000 gross energy consumption in Italy will total 6.7 quads, orabout 25% above the 1976 level, and that the E/GDP index (1976 = 100) will decline to about 79, with the residential and industrial sectors accounting for almost all of the decline.

13683 (ORAU/IEA—79-21(M)) **Japan: estimates of future energy/GNP relationships in energy use.** Edmonds, J.A.; Allen, E.L. (Oak Ridge Associated Universities, Inc., Washington, DC (USA). Inst. for Energy Analysis). Dec 1979. Contract EY-76-C-05-0033. 95p. Dep. NTIS, PC A05/MF A01.

In many ways Japan's recent economic experience is unparalleled in the OECD. Its GNP soared during the 1960s and early 1970s. In the 11 years following 1960, GNP tripled, and by 1976 had almost quadrupled. Japan's economic achievements are all the more impressive in light of the fact that, unlike Western European and North American OECD partners, Japan neither experienced an extended postwar baby boom nor allowed large numbers of foreign workers to enter the labor force. Rapid economic growth was accompanied by a parallel expansion of energy demand. Between 1960 and 1970, energy consumption more than doubled, and by 1976 had almost doubled again. Nothing in the analysis indicates that Japan's role as growth leader will be altered, even though economic expansion will be at a slower tempo. An early end is projected to the dramatic downward trend in fertility, with total fertility settling near 1.8. Productivity and GNP growth rates are also expected to lead the OECD, though a perceptible decline is anticipated. As a consequence of continued rapid economic expansion, Japan's energy consumption is projected to more than double between 1976 and 2000, a growth from 12.85 x 10^{15} Btu(quads) to 28.17 quads. At the same time GNP is projected to triple, accompanied by lowering of the Japanese energy/GNP ratio by 30%. Industrial and transportation sector energy efficiency gains are expected to lead the way, with residential and commercial sectorconsumption growing almost abreast with GNP. The delayed home appliance revolution is expected to offset much of the gains from slow population growth. On the other hand, the Japanese automobile population explosion is expected to proliferate new, more energy-efficient automobiles throughout the economy, rapidly raising overall fleet performance. A significant shift toward water transport of freight also improves the overall performance of the transport sector.

13684 (ORNL/TM—6951) **Energy availabilities for state and local development: 1975 data volume.** Mills, J.B.; Rice, P.L.; Vogt, D.P. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 285p. Dep. NTIS, PC A13/MF A01.

The supply, demand, and net imports of seven fuel types of four final consuming sectors for Bureau of Economic Analysis Areas (BEAs), states, census regions, and the nation in 1975 are presented. The data are formatted to present regional energy availability from primary extraction as well as from regional transformation processes. Extensive tables depict energy balances between availability and use for each specific fuel. In keeping with the Metric Conversion Act of 1975, this volume is reported in joules rather than in Btu's. The objective of this series is to provide a consistent base of historic and projected energy information within a standard format. Such a framework should aid regional policymakers in their consideration of regional-growth issues that may be influenced by the regional energy system. For analysis of specific regions, however, this basic data should be supplemented by additional information which only the local policy analyst can bring to bear in his assessment of the energy conditions that characterize his region.

13685 (PB—292102) **New York State institutions related to energy in the tri-state region. Working paper.** Aron, J. (New York Regional Energy Study, NY (USA)). Oct 1973. 83p. NTIS, PC A05/MF A01.

The possible impact of areawide residential location policy on future residential electricity usage in the Tri-State Metropolitan Region centering on New York City is investigated. In this report, primary emphasis is given to the major state agencies with direct responsibilities for policy-making in electric energy: the Public Service Commission, State Board on Electric Generation Siting and the Environment, Power Authority of the State of New York, and Atomic Space and Development Authority. The recent changes in the Public Service Commission are discussed and assessed for their effect on decision making. State agencies with minor energy-related jurisdictions and the major investor-owned utilities of New York also are discussed.

13686 **Future world energy demand versus new energy technologies.** Hauser, L.G. (Westinghouse Electr Corp, East Pittsburgh, Pa). pp 5p, Paper F 79 653-7 of 1979 IEEE summer power meeting. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From 1979 IEEE summer power meeting; Vancouver, Canada (Jul 1979).

Future world energy demand will be predominately influenced by population growth in the various sectors of the world. The combination of the high population growth rate of developing nations with their high growth rate in energy demand per capita results in a complete reversal of energy use patterns by the year 2000, and a potential shortfall of 25 million barrels per day of oil equivalent. New technologies such as coal gasification, MHD, nuclear breeders and solar power can only, even under the most favorable conditions, supply one half of this potential shortfall.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 13050, 13126, 13678, 13747, 13758, 14217

13687 (CONF-800111—1) **Comprehensive analysis of critical interactions possible.** Wilbanks, T.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 39p. Dep. NTIS, PC A03/MF A01.

From Annual conference of the American Association for the Advancement of Science; San Francisco, CA, USA (4 Jan 1980).

In the strictest sense, a comprehensive analysis of interactions having a bearing on energy policy is not now possible, and it may never be. Assuming that policymaking will benefit from developing as much of this capability as possible, this paper identifies the major shortcomings at present and the principal reasons for them. In conclusion, it suggests some strategies for closing the gap.

13688 (DOE/TIC—10203(App.A)) **National Energy Plan II, May 1979. Appendix A: world oil prices.** (Department of Energy, Washington, DC (USA). Office of Analytical Services). 1979. 65p. Dep. NTIS, PC A04/MF A01.

In formulating the Second National Energy Plan (NEP-II) the US DOE recognized the immense uncertainty related to forecasting world oil prices - whether the forecast is for next year, a decade from now, or for the year 2020. Recognition of uncertainty, however, does not help government or private decision makers who must base today's energy decisions on some expectation about future world oil prices. Thus, NEP-II, published in May 1979, provides a range of reasonable and internally consistent expectations about future world oil prices for use in performing domestic energy analysis. This appendix reports the detailed assumptions and projections used to develop the NEP-II world oil price cases. This report consists of three major sections. The first section presents assumptions about potential world demand and production of oil, assuming constant real future world oil prices. Included is a discussion of alternative theories of OPEC behavior. The second section presents world oil price paths generated by mathematical models of world oil supply and demand. The models calculate oil prices that act through price elasticities to change the assumed constant-price oil demand and supply conditions to achieve a balanced oil market. The final section synthesizes the various model projections into the range of world oil price cases used in NEP-II and reports major conclusions resulting from the world oil price analysis.

13689 (EMD—80-22) **Policy conflict - energy, environmental, and materials: automotive fuel-economy standards' implications for materials.** (General Accounting Office, Washington, DC (USA)). 5 Feb 1980. 47p. General Accounting Office, 441 G Street, NW, Washington, DC.

Report to the Congress of the United States by the Comptroller General.

The demands for energy conservation, environmental protection, and stable raw material supplies and prices are strongly competitive, and the complexity of this relationship has not been recognized in forming Federal policy. The means for resolving conflicts through coordinated economic and policy analysis is lacking, and implications for potentially affected materials industries, inadequate. A comprehensive policy for reconciling these competing goals is still far away, as this case study of automobile fuel-economy standards illustrates.

13690 (PB—291783) **Summary of energy supply, demand, and pricing evaluations. Technical report (final).** Thompson, R.G.; Stone,

J.G.; Singleton, F.D. Jr. (Houston Univ., TX (USA)). Mar 1977. 36p. NTIS, PC A03/MF A01.

A partial listing of contents includes: Results of the modeling evaluations for 1985 basic policy evaluations; Partial vs. Complete deregulation; Alternative policy options for partial deregulation; Comparison of fossil energy bills for marginal and input prices.

13691 (PB—292151) **Electric power development in the pacific northwest region: institutional commitments and alternatives, phase 2. Completion report, 1 July 1976—30 June 1977.** Lee, K.N.; Marts, M.E.; Klemka, D.L. (Washington Univ., Seattle (USA). Inst. for Environmental Studies). 19 Jan 1979. 158p. NTIS, PC A08/MF A01.

The report extends the work done in an earlier Water Research Center study of regional electric power planning in the Pacific Northwest. During 1977 and 1978 a complex set of legislative packages was introduced and debated in Congress and the region. These proposals aimed at comprehensive revision of the institutional structure of electric power allocation and planning in the Northwest; the existing structure is based on the Bonneville Project Act of 1937, and has been revised incrementally since then, as described in our earlier report. None of these legislative reformulations was successful, and the 95th Congress adjourned with a commitment to take up the question of regional power planning again in 1979. With interregnum prevailing in the region, there is need for evaluating the alternatives proposed, as well as development of new institutional concepts. Discussed are (1) premises for institutional redesign; (2) functions that must be carried out at the regional level; (3) prospects for alternative institutional orders emerging from the present political deadlock. In particular, it is argued that the costs and environmental impact of regional energy development will keep power planning enduringly controversial. Accordingly, leadership at the regional level will need to play a larger, more visible role than in the past. Two means by which such leadership might be given the institutional strength needed are (a) reallocation of low-cost federal hydropower on an incentive basis, rather than by either public or residential preference; or (b) the encouragement of a regional wholesale power market.

13692 (PB—292544) **Politics of energy: case study of Storm King controversy. Working paper.** Aron, J.; Shienbaum, E. (New York Regional Energy Study, NY (USA)). Jul 1974. 46p. NTIS, PC A03/MF A01.

This report focuses on the politics of energy in its discussion of Con Edison's efforts to construct a hydroelectric plant at Storm King. It describes Con Edison's efforts to acquire a site in Cornwall, New York, for the construction of a large hydroelectric pumped-storage plant which would serve as a large electric storage battery for use during periods of peak demands for electric power in the utility's service territory. Also presented is the orientation and behavior of the participants in the controversy: Con Edison, FPC and related federal officials, New York State, the locality, Scenic Hudson Preservation Conference, New York City and the courts. The many issues which surfaced as integral considerations in the decision-making process since the onset of the Storm King controversy are analyzed. Finally, the significance of the Storm King controversy for decision-making in the siting of power plants in the New York area is summarized.

13693 (PB—297064) **Northeast energy policy 1978, significant energy laws enacted during the 1978 state legislative sessions in the ten northeastern states.** Abrams, A.J. (Northeastern Legislative Leaders Energy Project, Albany, NY (USA)). Nov 1978. 14p. NTIS, PC A02/MF A01.

Sixty-one significant energy laws produced by the 1978 legislatures of the ten Northeastern states are listed according to state, bill number, subject, and description. The subjects are conservation, regulation and development, alternate energy, and rate structures. The laws center on institutionalization of energy administration, separation of siting functions from regulatory functions, continued progress in environmental protection with some slow-down in momentum, and continued progress in efforts to ease the consumer's burden. Included in the legislation is a 21 bill package, passed by New York State, which contains a master energy plan and siting law; a lifeline law by New Jersey; a new state energy office for Delaware; a time-of-day, time-of-use law adopted by New Hampshire; and a bottle law adopted by Connecticut following Maine and Vermont. Legislative officers for the Senate, House and/or General Assembly for each of the Northeastern states are listed.

13694 (PNL-SA—7020) **Analysis of Federal incentives used to stimulate energy production.** Cone, B.W.; Fassbender, A.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 9p. (CONF-7810223—1). Dep. NTIS, PC A02/MF A01.

From 6. annual conference of the Atlantic Economic Society; Washington, DC, USA (11 Oct 1978).

This document analyzes past and present Federal incentives to production of various energy sources in order to assist in the study and recommendation of Federal incentives for the development of solar energy. The document was divided into five parts: a survey of current thought about incentives for solar energy production; the theoretical approach to analyzing and characterizing incentives; a generic view of the energy incentive-creating landscape for 1976; analysis of the major energy sources (nuclear, hydro, coal, oil, and gas) along their trajectories from exploration to waste management, including their costs in 1976 dollars; and insights into potential incentives for solar policy.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 12985, 13669

13695 (DOE/TID/0033—1) **University manpower in fossil-energy research and development: a data-collection-feasibility study.** Finn, M.G. (Oak Ridge Associated Universities, Inc., TN (USA)). Sep 1979. Contract EY-76-C-05-0033. 47p. Dep. NTIS, PC A03/MF A01.

This report presents data on the manpower engaged in DOE-funded fossil energy research in universities. It identifies man-months of graduate student, faculty, and staff inputs to this research effort by discipline, and in most cases also by subdiscipline. The data presented come primarily from a review of research proposals and contracts in DOE files conducted during the summer of 1978. All of the projects examined were active during the 1977 and/or 1978 calendar years. While all the data come from this source, they were checked and classified by energy area using information from the Oak Ridge National Laboratory Energy Inventory, a compilation of energy research in progress. All data are presented in a form that permits their use in estimating the manpower implications of changes in DOE research budgets. The method used to collect the data is described, and a preliminary assessment of the feasibility of expanding the method to collect manpower data on all DOE-funded university research is made.

13696 (USDL-BULL—2005) **Technological change and its labor impact in five energy industries.** (Bureau of Labor Statistics, Washington, DC (USA)). Apr 1979. 71p. GPO $2.40.

This bulletin appraises some of the major technological changes emerging among selected American industries and discusses the impact of these changes on productivity and occupations over the next 5 to 10 years. It contains separate reports on the following five energy industries: coal mining (SIC 111, 121); oil and gas extraction (SIC 13); petroleum refining (SIC 2911); petroleum pipeline transportation (SIC 4612, 4613); and electric and gas utilities (SIC 491, 492, 493).

COAL

REFER ALSO TO CITATION(S) 12931, 12941, 12942, 12943, 12944, 12987, 13005, 13007, 13011, 13012, 13020, 13023, 13046, 13050, 13667, 13675

13697 **Gas from coal for industry: direct utilization of coal problems and solutions.** Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (1978). 125p. (IMMR—38-PD21-78; CONF-780169—). $7.50.

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

A separate abstract was prepared for each of 17 papers presented at the conference with the theme of Gas from Coal for Industry: Direct Utilization of Coal Problems and Solutions. Abstracts are included in the Energy Data Base (EDB) and 13 in Energy Research Abstracts (ERA); none are included in Energy Abstracts for Policy Analysis (EAPA). (MCW)

PETROLEUM

REFER ALSO TO CITATION(S) 13006, 13051, 13056, 13063, 13688

13698 (EMD—80-42) **Washington, DC, area home heating oil supplies adequate but at escalating prices.** Staats, E.B. (General Accounting Office, Washington, DC (USA)). 22 Jan 1980. 40p. General Accounting Office, Washington, DC.

Report to Senator John W. Warner by the Comptroller General of the United States.

The availability and escalating price of home heating oil in the Washington, DC, area for the winter of 1979 are discussed. The Department of Energy's lack of response to these rising prices is also discussed. Congress's appropriation of 1.6 billion dollars for low-income people to pay their energy bills is evaluated. Recommendations to the DOE concerning the rising cost of heating oil are included. (DC)

13699 (PB—292634) **Analysis of the energy and economic effects of the Iranian oil shortfall.** (General Accounting Office, Washington,

DC (USA). Energy and Minerals Div.). 5 Mar 1979. 51p. NTIS, PC A04/MF A01.

A partial listing of topic areas includes the following: The size of the shortfall; International aspects; Effects on the U.S. economy; Government options.

13700 Illinois petroleum shortage response plan non-transportation related measures. Chevy Chase, MD; Jack Faucett Associates (1979). 147p. (NP—24225). Illinois Inst. of Natural Resources, Springfield, IL.

Development and commercialization of new energy sources and energy conservation programs will remedy the long-term energy problem, but short-term quick-response programs are also needed to alleviate or mitigate the impacts of short-term petroleum problems. This report will be used to develop a response to the energy shortage experienced during the summer of 1979 and the possible shortage of petroleum products during the winter of 1979-1980. This report presents a series of nontransportation related energy shortage response measures. These measures center on the reduction of energy consumption in State and local government facilities, commercial and industrial buildings and in households through the direct and indirect reduction in the use of petroleum products and electricity for space cooling, heating, ventilation, water heating and lighting. Measures are also presented that will help to reduce energy consumption on farms during shortages. In addition, programs that the State may use to allocate petroleum products are described, if other measures are not effective due to low compliance levels. Almost all of these measures, with the exception of energy audits by businesses and the allocation program, can be implemented within 30 days.

NATURAL GAS

REFER ALSO TO CITATION(S) 13051, 13070, 13074, 13075, 13076, 13077, 13078, 13086, 13090, 13665, 13713, 13759

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 13056, 13114, 13118

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 12910, 12931

13701 (DOE/TIC—11093) **Presolicitation conference on project feasibility studies and cooperative agreements P.L. 96-126. Proceedings: January 15, 1980, Denver, Colorado.** (Department of Energy, Washington, DC (USA)). 1980. 162p. Dep. NTIS, PC A08/MF A01.

On November 27, 1979, the President signed the DOI and Related Agencies Appropriations Act for Fiscal Year 1980. That Act provides the $2.2 billion that was discussed at this Presolicitation Conference. That Act makes it clear that the purpose of the appropriation is to speed domestic development and production of alternative fuels as economically as possible. Included are gaseous, liquid or solid fuels, and chemical feedstocks derived from coal, oil shale, tar sands, lignite, peat, biomass, solid waste, unconventional natural gas, and other mineral or organic materials, other than crude oil or any derivative. Statements were made at the conference by Larry Lukens, Ralph Bayrer, and Stephen Mournighan. Questions posed by members of the audience from industry and the answers provided are included. A listing of the participants is given. (MCW)

ELECTRIC POWER

REFER ALSO TO CITATION(S) 13023, 13661, 13696, 13759, 13818, 14570

13702 (DOE/EIA—0057/1(79)) **Principal electric facilities: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13703 (DOE/EIA—0057/2(79)) **Principal electric facilities: Delaware, New Jersey and New York.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Delaware, New Jersey, and New York. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13704 (DOE/EIA—0057/3(79)) **Principal electric facilities: District of Columbia, Maryland, Pennsylvania, Virginia and West Virginia.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Washington, D.C., Maryland, Pennsylvania, Virginia, and West Virginia. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13705 (DOE/EIA—0057/4(79)) **Principal electric facilities: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13706 (DOE/EIA—0057/5(79)) **Principal electric facilities: Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13707 (DOE/EIA—0057/6(79)) **Principal electric facilities: Arkansas, Louisiana, New Mexico, Oklahoma and Texas.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, or industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13708 (DOE/EIA—0057/7(79)) **Principal electric facilities: Iowa, Kansas, Missouri and Nebraska.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Iowa, Kansas, Missouri, and Nebraska. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13709 (DOE/EIA—0057/8(79)) **Principal electric facilities: Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. Utilities are listed by

name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13710 (DOE/EIA—0057/9(79)) **Principal electric facilities: Arizona, California and Nevada.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in California, Arizona, and Nevada. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13711 (DOE/EIA—0057/10(79)) **Principal electric facilities: Idaho, Oregon and Washington.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Idaho, Oregon, Washington. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13712 (DOE/EIA—0057/11(79)) **Principal electric facilities: Alaska, Hawaii, Puerto Rico and Virgin Islands.** (Department of Energy, Washington, DC (USA). Energy Information Administration). 1979. 48p. Dep. NTIS, PC A03/MF A01.

A detailed map is presented covering information to June 30, 1978 on the principal electric facilities in Alaska, Hawaii, Puerto Rico, and Virgin Islands. Utilities are listed by name and type of owner (private, cooperative, municipal, state or territory, Federal, industrial). Individual plants are identified on the map with information on MW capacity and type (steam, nuclear, internal combustion, hydro, combustion turbine, combined cycle) of plant and plant location given in tables. Sites of transmission lines are identified.

13713 (DOE/EIA—0147/8-9(78)) **Financial statistics of electric utilities and interstate natural gas pipeline companies.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1978. 19p. Dep. NTIS, PC A02/MF A01.

The financial statistics for August 1978 for privately owned electric utilities and interstate natural gas pipeline companies are summarized and tabulated. (LCL)

13714 (NUREG/CR—1147) **Econometric model for the disaggregation of state-level electricity demand forecasts to the service area.** Tepel, R.C.; Alvic, D.R.; Jay, J.M.; Thorne, A.D. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 95p. (ORNL/NUREG/TM—359). Dep. NTIS, PC A05/MF A01.

An econometric model for the disaggregation of state-level electricity demand forecasts to the service area developed by Oak Ridge National Laboratory (ORNL) is presented. Based on demand models for the service area and the remainder of the state in which it is located, a model which explains the service area's share of the state's demand is developed and estimated for six service areas using econometric techniques. The share is then forecasted and combined with the forecasts for state demand presented in Regional Econometric Model for Forecasting Electricity Demand by Sector and by State (ORNL/NUREG-49) to obtan service-area forecasts to 1990. Results indicate that some service areas differ dramatically from the state and the region of which they are a part. The historic difference in the growth rate of electricity demand is reflected in the forecasted future growth rates generated by the model. This implies that the application of regional or state growth rates to some particular service areas may be inappropriate. The major causes of the difference between the areas seem to be differences in the responsiveness and growth of prices, income, populatzon, and industrial activity.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 13814

13715 (DSE—3411-T1) **Utility rate structures and distributed thermal energy storage: a cost/benefit analysis. Basic research report, October 1978-February 1979.** Koening, E.F.; Cambel, A.B. (George Washington Univ., Washington, DC (USA). School of Engineering and Applied Science). Feb 1979. Contract ET-78-S-01-3411. 44p. Dep. NTIS, PC A03/MF A01.

This paper examines three alternative methods by which electric utilities might take advantage of distributed thermal energy storage to smooth out their load profiles. These three methods are: time-specific rates, time-invariant rates with subsidized storage, and direct load controls. The optimal form of each of these policies is determined, and formulas indicating the relative desirability of each policy are developed.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 13064, 13727, 13730, 13752, 13763, 13824

UNCONVENTIONAL SOURCES AND POWER GENERATION

13716 (PB—296364) **Alternative energy systems in rural Mauritania.** Dunham, D.C. (Volunteers in Technical Assistance, Inc., Mt. Ranier, MD (USA)). Sep 1977. 67p. NTIS, PC A04/MF A01.

This report contains background data and recommendations on the potential of simple demonstration projects in the use of alternate energy sources in Mauritania, West Africa. The study is limited to those energy applications which would use the materials and technical skills available in the area at this time, i.e., solar energy, wind energy, and water power.

SOLAR

REFER ALSO TO CITATION(S) 13238, 13239, 13318, 13355, 13361, 13660

13717 (PB—294833) **Solar plan for the state of Washington. appendix b. solar energy resources within the state of Washington.** Gray, G. (Washington Univ., Seattle (USA). Applied Physics Lab.). 1 Mar 1978. 207p. NTIS PC A10/MF A01.

A partial listing of contents includes: solar radiation in the state of Washington; wind resources; heating and cooling degree days; long-term renewable biomass resources; hydro resources; solar water heating; the potential for solar-generated process heat; the potential for solar energy utilization within the agricultural sector; solar status--Washington state lending institutions, insurance companies, developers, appraisers, and realtors, architects, engineers, manufacturers, and consultants, governmental agencies, distributors, builders, and craftsmen.

GEOTHERMAL

REFER ALSO TO CITATION(S) 13406, 13407, 13408, 13409, 13410, 13412, 13413, 13414, 13415, 13416, 13417, 13418, 13419, 13433

OTHER

REFER ALSO TO CITATION(S) 13219, 13226, 13300, 13447, 13747, 13821, 13822

13718 (SERI/TR—332-360(Vol.1)) **Biotechnology for producing fuels and chemicals from biomass: recommendations for R and D. Volume I. Synopsis and executive summary.** Villet, R. (Solar Energy Research Inst., Golden, CO (USA)). Dec 1979. Contract EG-77-C-01-4042. 29p. Dep. NTIS, PC A03/MF A01.

Areas of research and development judged to be crucial for establishing a biotechnology of biomass processing are identified. Two general avenues are recommended for R and D: (1) in the near term, revival of the older fermentation technology and improvement of processing efficiencies; and (2) in the longer term, the development of novel biotechnological processes, such as for the conversion of lignocellulosic biomass to fuels and chemicals. Recommended R and D ranges from work in moleular genetics to biochemical engineering aspects of plant design. It is recommended that the R and D strategy be designed as an integration of three disciplines: biochemical engineering, microbial genetics, and biochemistry. Applcations of gene-transfer methodology and developments in continuous fermentation should be pursued. Currently, economic incentive for the use of biological conversion processes for producing fuels and chemical feedstocks from biomass is marginal. But as the imported fraction of US oil supply grows and hydrocarbon costs mount, the market is beginning to motivate a quest for substitutes. The commercial potential for biotechnology for establishing a renewable resources chemicals industry appears similar to the potential of the computer and microelectronics field several decades ago.

ENERGY CONVERSION

MHD GENERATORS

13719 (PB—293149) **A legal study relating to coal development - population issues. volume II. Land use planning and growth control: statutory responses from outside the region. Final report, June—September 1974.** Scott, J.J. (Kutak, Rock, Cohen, Campbell, Garfinkle and Woodward, Omaha, NE (USA)). Sep 1974. Contract OWRC-10470004. 204p. NTIS, PC A10/MF A01.

Volume Two is a collection of selected state statutes, county ordinances and municipal ordinances from states other than Montana, North Dakota, and Wyoming, pertaining to land-use control and other means of responding to the problems of rapid population growth. Each of these legislative responses was included because it represents an innovative departure from traditional patterns with respect to the issues which confront the States of Montana, North Dakota and Wyoming with increasing frequency. The initial section, which provides an example of a statute which sharply contrasts with the customary lack of substantive state involvement in land-use control, is followed by a section illustrating statutes which allow ultimate control of land-use to remain with the county or municipal government but establish a state agency to act as an advisor on land-use questions. The next section of Volume Two is composed of statutes which permit local governments to control land-use within their jurisdictions but establish the specific terms according to which that control must be exercised and provide for direct supervision to insure that those terms are implemented in the required manner. Another section consists of a number of state statutes applicable only to limited and specifically defined problems. These include laws dealing with preservation of open space and agricultural lands, limiting the location of certain facilities for environmental reasons, establishing controls on waste disposal, authorizing purchase by the state of environmentally endangered lands, and creating special tax concepts relevant to growth control. The final section includes a county ordinance and two municipal ordinances which have been extremely influential in the development of current thought concerning local solutions to the problems of rapid growth.

DESIGN AND DEVELOPMENT

13720 (AD-A—062702) **Mhd generator investigations. Annual report 1 oct 76-31 dec 77.** Tate, E.; Zauderer, B. (General Electric Co., Philadelphia, PA (USA). Space Div.). 1977. Contract N00014-73-C-0039. 76p. NTIS, PC A05/MF A01.

The gas dynamic and plasma characteristics achievable in electric driven shock tubes are not sufficient to produce large scale self excited MHD generator operation in noble gases, primarily due to radiation cooling. It is recommended that alternate working gases be investigated and/or the East facility be upgraded with explosive drivers to achieve ultra high pressure, radiatively self-absorbing plasmas. Candidate gases are cesium or gaseous or metallic compound, seeded noble gases. The requirements for self excited MHD generator operation have been established. Adequate electrical conductivity and low electrode losses are essential. It is recommended that conductivity improvements be achieved by the methods noted above. Electrode losses can be reduced by either alkali metal coated or impregnated electrodes. Serious discrepancies exist between theory and experiment of electrical conductivities of high pressure plasmas. Also the experimental data base is inadequate. Work in this area is critical to an understanding of these plasmas in MHD generators.

13721 (N—79-17335) **Evaluation of the ECAS open cycle MHD power plant design. Final report.** Seikel, G.R.; Staiger, P.J.; Pian, C.C.P. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1978. Contract EF-77-A-01-2674. 27p. NTIS, PC A03/MF A01.

The Energy Conversion Alternatives Study (ECAS) MHD/steam power plant is described. The NASA critical evaluation of the design is summarized. Performance of the MHD plant is compared to that of the other type ECAS plant designs on the basis of efficiency and the 30-year levelized cost of electricity. Techniques to improve the plant design and the potential performance of lower technology plants requiring shorter development time and lower development cost are then discussed.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 13725

DUCT ENGINEERING AND FLUID DYNAMICS

REFER ALSO TO CITATION(S) 14461

THERMOELECTRIC GENERATORS

PERFORMANCE AND TESTING

13722 (SAN—0959-T2) **Thermoelectric generator testing and RTG degradation mechanisms evaluation. Progress report No. 33.** Lockwood, A.; Stapfer, G. (Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1979. Contract EY-76-A-03-0959. 49p. Dep. NTIS, PC A03/MF A01.

The n-type selenide legs after 10,600 hours continue to show agreement with the 3M Co. published data. In the ingradient testing after 11,378 hours the n-legs show comparable performance to the reported 3M data. The new design p-type legs were placed on test. The remaining MHW generator on test Q1-A has accumulated 19,567 hours and performance remains stable. Three 18 couple modules S/N-1, 2, and 3 previously tested at RCA were received for JPL test and evaluation. S/N-1 has 1700 hours testing at JPL with results indistinguishable from those at the end of RCA testing in 1977. The performances of LES 8/9 generators are following DEGRA predications after 31,824 hours. The performance of the Voyager 1 and 2 RTGs is reported after 19,577 hours and 20,122 hours of operation, respectively.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 13722, 13916

THERMIONIC CONVERTERS

MATERIALS, COMPONENTS, AND AUXILIARIES

13723 (N—79-17327) **Work function determination of promising electrode materials for thermionic converters. Final report.** Jacobson, D. (Arizona State Univ., Tempe (USA)). 1977. 66p. NTIS, PC A04/MF A01.

Work performed on this contract was primarily for the evaluation of selected electrode materials for thermionic energy converters. The original objective was to characterize selected nickel based superalloys up to temperatures of 1400 K. It was found that an early selection, Inconel 800 produced a high vapor pressure which interfered with the vacuum emission measurements. The program then shifted to two other areas. The first area was to obtain emission from the superalloys in a cesiated atmosphere. The cesium plasma helps to suppress the vaporization interference. The second area involved characterization of the Lanthanum-Boron series as thermionic emitters. These final two areas resulted in three journal publications which are attached to this report.

FUEL CELLS

REFER ALSO TO CITATION(S) 12905, 13034

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 12932

13724 (N—79-22246) **Control of volume resistivity in inorganic organic separators.** Sheibley, D.W.; Manzo, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1979. 17p. NTIS PC A02/MF A01.

Control of resistivity in NASA inorganic-organic separators is achieved by incorporating small percentages of high surface area, fine particle silica with other ingredients in the separator coating. The volume resistivity is predictable from the surface area of filler particles in the coating. The approach is applied to two polymer-plasticizer -filler coating systems, where the filler content of each is below the generally acknowledged critical pigment volume concentration of the coating. Application of these coating systems to 0.0254 cm thick (10-mil) fuel cell grade asbestos sheet produces inexpensive, flexible, microporous separators that perform as well as the original inorganic-organic concept, the Astropower separator.

13725 (SAN—1485-1) **Evaluation of MHD materials for use in high-temperature fuel cells.** Guidotti, R. (Montana Energy and MHD Research and Development Inst., Inc., Butte (USA)). 15 Jun 1978. Contract EC-77-C-03-1485. 173p. Dep. NTIS, PC A08/MF A01.

The MHD and high-temperature fuel cell literature was surveyed for data pertaining to materials properties in order to identify materials used in MHD power generation which also might be suitable for component use in high-temperature fuel cells. Classes of MHD-electrode materials evaluated include carbides, nitrides, silicides, borides, composites, and oxides. Y_2O_3-stabilized ZrO_2 used as a reference point to evaluate materials for use in the solid-oxide fuel cell. Physical and chemical properties such as electrical resistivity,

coefficient of thermal expansion, and thermodynamic stability toward oxidation were used to screen candidate materials. A number of the non-oxide ceramic MHD-electrode materials appear promising for use in the solid-electrolyte and molten-carbonate fuel cell as anodes or anode constituents. The MHD-insulator materials appear suitable candidates for electrolyte-support tiles in the molten-carbonate fuel cells. The merits and possible problem areas for these applications are discussed and additional needed areas of research are delineated.

13726 Formulated plastic separators for soluble electrode cells. Sheibley, D.W. US Patent 4,133,941. 9 Jan 1979. Filed date 10 Mar 1977. 8p.

The fabrication and milling of membranes, comprising a hydrochloric acid-insoluble sheet of a mixture of a rubber and a powdered ion transport material, are described. The sheet can be present as a coating upon a flexible and porous substrate. These membranes can be used in oxidation-reduction electrical accumulator cells wherein the reduction of one member of a couple is accompanied by the oxidation of the other member of the couple on the other side of the cell and this must be accompanied by a change in chloride ion concentration in both sides.

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

REFER ALSO TO CITATION(S) 13989

ELECTROMECHANICAL CONVERTERS

REFER ALSO TO CITATION(S) 13438

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 13684, 13700

BUILDINGS

REFER ALSO TO CITATION(S) 13347, 13808, 13824

13727 (CONS—0261-T1) **Estimating energy impacts of residential and commercial building development. A manual for the Pacific Northwest and Alaska.** (Mathematical Sciences Northwest, Inc., Bellevue, WA (USA)). 22 Feb 1979. Contract EW-78-C-51-0261. 178p. Dep. NTIS, PC A09/MF A01.

This energy-impact manual presents information on energy implications of new building design and operation, providing a reasonably accurate means of assessing the total energy impact of new construction in the commercial and residential sectors. While developed specifically for the states of Alaska, Idaho, Oregon, and Washington, much of the data used are national averages; the procedures described are applicable to other regions of the nation, with appropriate adjustments for climatic differences. The manual is organized into three parts, each covering one aspect of the energy impacts of building development. Part I addresses the energy impact of erecting the building(s). This includes the energy cost of grading and excavating and other site preparation. It also takes into account the energy embodied in the fabrication of materials used in building construction, as well as the energy cost of transporting materials to the site and assembling them. Part II focuses on the end use of energy during normal building operation, i.e., the energy consumed for space heating, cooling, lighting, water heating, etc. A simplified calculation sequence is provided which allows the user to estimate the consumption of most combinations of building orientation, characteristics, and operating conditions. Part III examines the relationship of land use to energy consumption, principally the transportation energy impact of various land-development patterns, the embodied energy impacts of infrastructure requirements, and the impacts of various orientation and siting schemes. (MCW)

13728 (COO—4649-8, pp 29-45) **Air conditioning and refrigeration.** Lee, J.S.; Azer, N.Z.; Sparrow, E.M. Oct 1979.

In Research workshop on energy conservation through enhanced heat transfer.

The state-of-the-art in heat transfer augmentation in the air conditioning and refrigeration industry is reviewed, problem areas are discussed, general recommendations are made, and the prospects for future advances are evaluated. (LCL)

13729 (COO—10117-1) **Insulated siding. Semi-annual technical progress report.** (General Plastics Corp., Marion, IN (USA)). 18 Dec 1979. Contract FG02-79R510117. 8p. Dep. NTIS, PC A02/MF A01.

Progress in developing insulated panels as prefabricated siding for buildings is reported. The 2-ft wide panels contain Thermax insulation, vinyl facing, and vertical suspension members. Photographs and drawings are included. (LCL)

13730 (DOE/CS—0129) **Energy performance standards for new buildings: economic analysis.** (Department of Energy, Washington, DC (USA). Office of Building and Community Systems). Jan 1980. 402p. Dep. NTIS, PC A18/MF A01.

This assessment determines the major economic impacts of the implementation of the standards on affected groups, and evaluates the effectiveness of the standards as an investment in energy conservation. The analyses examine the impacts on individual owners, construction industry, and the Nation. Chapter 2, Summary, briefly displays the results of the analysis. Chapter 3, Approach, describes the methodology used to evaluate the standards for the various building types and perspectives. The basis and structure for evaluating the standards' impacts on occupants and the Nation are described. Chapter 4, Building Microeconomics, evaluates the net economic effects of changes in building cost and energy use for three categories of buildings: single family residential, commercial and multifamily residential, and mobile homes. Chapter 5, Primary National Impacts, develops forecasts of energy savings and national costs and benefits both with and without implementation of the standards. Chapter 6, Impacts on Selected Building Industries, estimates changes in labor and material use in building construction and assesses the importance of these changes. Chapter 7, Net National Impacts, assesses the effects of changes in energy consumption and construction of new buildings on the national economy, including such factors as national income, investment, employment, and balance of trade. Details of models and data bases used in the analysis are included in Appendixes A through I. (MCW)

13731 (GRI—79/0007) **HVAC market.** Lewis, J.E. (Hayes/Hill, Inc., New York (USA)). 7 Nov 1979. 106p. NTIS.

Results of studies initiated to identify and evaluate the commercialization issues and potential for gas-fired heat pumps are reported. This report should be considered as a general overview, rather than a comprehensive analysis, that provides some interesting perspectives on key commercialization issues, the development of marketing strategies for new products and the general situation in the HVAC market.

13732 (LA-UR—80-357) **DOE-2 Verification Project: Phase I results.** Diamond, S.C.; Hunn, B.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800101—5). Dep. NTIS, PC A02/MF A01.

From Systems simulation and economics analysis conference; San Diego, CA, USA (23 Jan 1980).

A computer program, designated DOE-2 (formerly DOE-1), has been developed to provide architect/engineers with a public domain tool for fast and economic energy analysis of buildings. Los Alamos Scientific Lab. has developed and implemented a program plan to verify DOE-2. Phase I of this plan is an analytical verification of the DOE-2 program as a computational unit rather than as separate algorithms. Work on Phase I of the DOE-2 Verification Project is nearly complete. Results of the crosscheck with ASHRAE loads calculative procedures, as well as the results of a line-by-line check of program constants and flag-setting algorithms, are reported. Also presented are results of empirical tests of the full DOE-2 program, including comparisons with measured energy consumption, and preliminary results of a study of the user interpretation of input data on predicted results.

13733 (LBL—6865) **Saving half of California's energy and peak power in buildings and appliances via long-range standards and other legislation.** Rosenfeld, A.H.; Goldstein, D.B.; Lichtenberg, A.J.; Craig, P.P. (California Univ., Berkeley (USA); California Univ., Davis (USA). Dept. of Applied Science). 10 May 1978. Contract W-7405-ENG-48. 54p. Dep. NTIS, PC A04/MF A01.

If energy and peak electric power were valued at their replacement costs, new buildings (including homes) and appliances would consume roughly half of what they do today, and old buildings would be retrofit so as to achieve similar reductions. The potentials for improved use of energy in refrigerators, homes, and stoves, and peak power shaving by storage of chilled water for air-conditioning are discussed. State legislation needed to achieve these reductions, particularly long-range standards, and the mechanisms required to make them acceptable is described.

13734 (LBL—9483) **High frequency lighting systems. Review of previous systems performance records, proposal for optimum system anthology: bibliography.** Campbell, J.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1979. Contract W-7405-ENG-48. 86p. Dep. NTIS, PC A05/MF A01.

The development of high frequency fluorescent lighting systems for providing higher illumination levels for large buildings at lower operating costs is reviewed and summarized for the past 27 years. Data on the design, performance, and economics of systems operating at 360 Hz to 3000 Hz are presented. (LCL)

13735 (NBS-BSS—119) **Economic evaluation of windows in buildings: methodology.** Ruegg, R.T.; Chapman, R.E. (National Bureau of Standards, Washington, DC (USA)). Apr 1979. 105p. GPO.

This study, which is one part of an NBS interdisciplinary project on windows, is aimed at improving the cost-effectiveness of window selection and use in buildings. It develops and illustrates a life-cycle-costing evaluation model and computer program for assessing for alternative window systems the net-dollar impact of acquisition, maintenance and repair, heating and cooling energy gains and losses, and artificial lighting and daylighting trade-offs. The method is applicable to the evaluaion of many different window sizes, design, accessories, and uses, both for new and existing residential and commercial buildings. Two step-by-step examples of evaluating selected window alternatives in a residence and in an office building in Washington, D.C. serve to illustrate the application of the method. A companion report, A Regional Economic Assessment of Selected Window Systems, presents results of eight additional residential case studies and eight additional commercial case studies. While the emphasis of this report is on the method of evaluation, the companion report focuses on summarizing results of a regional analysis in a form that will be convenient for use by building owners, operators, designers, financiers, and builders - those whose interest centers on the actual implementation of research results.

13736 (NCEI—0009) **Development of the Duke University Building Energy Analysis Method (DUBEAM) and generation of plots for North Carolina.** Sud, I.; Wiggins, R.W. Jr.; Chaddock, J.B.; Butler, T.D. (Duke Univ., Durham, NC (USA). Center for the Study of Energy Conservation). 30 Nov 1979. 331p. NTIS, PC A15/MF A01.

The study is directed toward developing a method of estimating energy savings which will be both accurate and easy to apply. Estimating the energy savings from feasible energy conserving opportunities requires a determination of the energy usage by various components of the existing building, and the projected energy usage by the building after the proposed energy conserving modifications. (TFD)

13737 (ORNL/TM—7059) **Emergency petroleum conservation: a review and analysis of selected measures.** Boercker, F.D.; Balasubramaniam, M.; Hull, E.; Savadelis, J.; Valentini, J.J. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 151p. Dep. NTIS, PC A08/MF A01.

ORNL was asked by the Economic Regulatory Administration to (1) collect, screen, and recommend a limited number of emergency measures that might conserve petroleum in residential and commercial buildings and in commercial transportation and (2) provide a detailed analysis of the energy savings and the economic and environmental impacts associated with restricting the hours of operation of commercial buildings. A total of 41 emergency measures were identified that might conserve petroleum, and these were reduced to a list of five that seemed most promising. Analysis of the measure to restrict hours of operation for commercial buildings shows that it might save 4 to 6% of annual commercial building energy use. The type of fuel conserved would vary widely from region to region, and appreciable negative economic impacts would result from implementing the measure.

13738 (PB—294659) **Energy report: climate, wind and heat loss. Technical memo (final).** (Albany County Planning Board, NY (USA)). May 1978. Contract HUD-D-11467. 26p. NTIS PC A03/MF A01.

This report focuses on climate and wind as they effect heat loss in structures, and recommends building orientation and wind control mechanisms which can be employed to mitigate these effects. A bibliography of primary sources is provided.

13739 (PB—294713) **Factors affecting product lifetime, a study in support of policy development for waste reduction. Final report.** Conn, W.D. (California Univ., Los Angeles (USA). School of Architecture and Urban Planning). Aug 1978. 200p. NTIS PC A09/MF A01.

An exploratory study has examined factors affecting the lifetimes of selected small electrical appliances, to assist in the development of policies to extend these lifetimes (for the purposes of conserving resources, protecting the environment, and reducing the costs of solid waste management). The study included: a consumer survey; in-depth interviews with manufacturers; and a limited investigation of second-hand markets.

13740 (PB—295551) **Center for building technology: a perspective - 1979.** (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). May 1979. 33p. NTIS PC A03/MF A01.

This report presents an overview of the National Bureau of Standards Center for Building Technology's research, its accomplishments, and ongoing projects. The mission of the Center for Building Technology is threefold: (1) to advance building technology by providing technical and scientific bases for criteria and standards that improve the usefulness, safety, and economy of buildings; (2) to provide technical assistance to all sectors of the buildings community; and (3) to develop improved techniques by which the end-users in buildings, communities and industrial processes can conserve energy.

13741 (PB—297429) **Thermal and lighting efficiency standards. Final report (revised) on task 2.** (Mathematical Sciences Northwest, Inc., Bellevue, WA (USA)). 7 Dec 1978. 196p. NTIS, PC A09/MF A01.

The major purpose of this study is to recommend an energy code for new building construction that meets or exceeds the intent of ASHRAE 90-75, a national consensus standard for energy conservation adopted by the American Society of Heating, Refrigeration and Air Conditioning Engineers. The principal effort has been the analysis of four building prototypes in three Washington locations to determine energy savings and cost-effectiveness for different construction standards. The analysis shows that the proposed standards do indeed save energy, and that they are economically justified and in some cases can result in lower initial costs. A rough estimate of state-wide cumulative savings is nearly 65 trillion Btu's for the period 1979 through 1985 if the proposed code is enacted. This savings is equivalent to 11.15 million barrels of oil or 18.95 billion kilowatt-hours.

13742 (PNL—3087) **Evaluation of resource impact factors versus social cost estimates in determining building energy performance standard levels.** Nieves, L.A.; Nesse, R.J.; Adams, R.C.; McDonald, C.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 123p. Dep. NTIS, PC A06/MF A01.

In order to increase the welfare of society through the implementation of a building energy-performance standard, a method is required by which the least-cost means of obtaining the desired space conditioning of a building can be estimated. In other words, a life-cycle cost model must be developed to simulate the energy-related building-design decisions that would take place if resources were being allocated efficiently. The cost-minimizing model must incorporate technically efficient conservation strategies and fuel-conversion equipment, and the prices used must reflect the social value of the fuels and capital equipment used. This report explores the feasibility of developing a factor that could be used to adjust a design energy budget to account for the external costs associated with that energy consumption. One such factor, RIF (resource impact factor) has been proposed by ASHRAE. Though ASHRAE suggested the RIF x RUF (resource utilization factor) multiplier concept, RIF's were not explicitly defined. Weber (1978) suggested that RIF be defined as a ratio of social costs to effective market price. The basis for a RIF used in conjunction with a RUF is evaluated here and is found lacking. To fill the gap, a social-cost approach is developed that addresses the goals of both RIF's and RUF's. The rationale for using such an approach stems from the existence of differences between retail prices and the actual social costs of fuels.

13743 (UCRL—83813) **Prospects for using improved climate information to better manage energy systems.** Quirk, W.J.; Moriarty, J.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 12p. (CONF-800309—2). Dep. NTIS, PC A02/MF A01.

From International workshop on the energy/climate interactions; Munster, F.R. Germany (3 Mar 1980).

The impacts that climate anomolies have had on energy systems in the United States, and the resulting impacts on society are described. It is pointed out that better use of climate information could alleviate some of the adverse consequences of these anomalies. Finally, the possibility of international cooperation in using climate information to avoid potentially worsening conditions during a gloval energy shortage is examined.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 13220, 13225, 13297

13744 (BNL—51067) **Survey of available technology for the improvement of gas-fired residential heating equipment. Final report.** Putnam, A.A.; Talbert, S.G.; Vergara, R.D.; Levy, A.; DeWerth, D.W.; Norris, T.R. (Battelle Columbus Labs., OH (USA); American

Gas Association Labs., Cleveland, OH). Aug 1979. Contract EY-76-C-02-0016. 198p. Dep. NTIS, PC A09/MF A01.

Available technology was surveyed as to possible application to more efficient gas-fired comfort heating and water heating in residences. Objectives were (1) to evaluate energy saving modifications and design approaches, including both retrofit and new systems, and (2) to identify RD and D required to bring to the marketplace those concepts that have a reasonable payback period. Over 60 concepts, including both retrofit devices and new designs, were identified on the basis of the study of the technical literature and discussions with various segments of industry. After evaluating each concept on the basis of expected initial cost, energy consumption, and operating cost, those concepts with a reasonably short payback period were considered from the point of view of RD and D needs. A principal recommendation covering several specific concepts was the study of condensing heat-exchanger systems. RD and D was recommended on both mechanical and aerodynamically valved pulse combustors, radiant burners, catalytic systems, heat pipe systems, self-powered heating units, and gas-fired heat pumps. Relative to retrofit concepts, recommendations covered the effects of derating on furnace corrosion and the methodology for predicting savings in individual homes. Need was also indicated for a methodology to optimize sizing of heating units and for data on energy demand requirements for integrated appliances. General recommendations related to systems control analysis, minimum venting requirements, and combustion air requirements in tight homes.

13745 (CONF-790987—, pp 25p, Paper 2) **Technology development for wood combustion commercialization.** Goldstein, S.N.; Gordon, J.J.; Newman, L.C.; Talib, A. (Mitre Corp., McLean, VA). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

An assessment of the technical, environmental, institutional, market, and economic readiness of wood harvesting and combustion is reported. The principal barriers to commercialization are identified. Recommendations from industry, utilities, public interest groups, and government are included. (DC)

13746 (CONF-790987—, pp 11p, Paper 9) **Wood commercialization program residential wood sector.** Ryan, J. (Dept. of Energy, Washington, DC). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

Residential uses for wood combustion are illustrated. The types of wood burning stoves available are demonstrated. The performance of wood burning appliances is evaluated. The potential impact of wood utilization is outlined. Some issues concerning wood commercialization are listed. The Space Condition Program is described. (DC)

13747 (CONF-790987—, pp 16p, Paper 10) **Assessment of proposed federal tax credits for residential wood burning equipment.** Hartmen, D.L. (Booz, Allen and Hamilton, Inc., Bethesda, MD). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

To assist DOE in conducting a policy review of whether or not tax credits should be provided under the Energy Tax Act of 1978 for wood burning equipment in home heating, this study was conducted. The following issues were researched: historical sales and market trends; oil savings vs tax revenue loss; performance and safety standards; environmental impacts; resource availability; balance of payments; consumer economics; employment and other social impacts; and the pros and cons of various DOE policy options. (DC)

13748 (CONF-790987—, pp 41p, Paper 12) **Improving the efficiency, safety, and utility of woodburning units.** Maxwell, T. (Auburn Univ., AL). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

Various aspects of wood heating are discussed. Methods for testing and rating the efficiency of wood burning units and accessories are described. Performance data for typical wood burning units are included. Safety aspects of woodburning units, especially as relates to creosote formation and chimney fires are discussed. Methods of communicating findings to the public are presented. Studies on improving the design of woodburning units in order to promote safe, clean and efficient use of wood as a fuel for residential heating are summarized. (DC)

13749 (CONF-790987—, pp 27p, Paper 13) **Circulating fireplace combustion efficiency studies.** Bulpitt, W.S. (Georgia Inst. of Tech., Atlanta). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The effects of changes on the gross steady-state thermal efficiency of a factory-built circulating fireplace were investigated. An existing calimeter room was utilized. The following parameters were evaluated: (a) efficiency and heat rate variations with fuel feed; (b) assessment of effect on thermal efficiency of circulating effects; (c) effects on fireplace performance of different types of fuel; (d) effects on performance of external combustion air; and (e) effects on performance of glass door use. It was anticipated that a number of tests would be performed using the calorimeter facility and that operating curves could be drawn using the data generated to assess the effects of parameter changes on fireplace performance.

13750 (CONF-790987—, pp 25p, Paper 14) **Firewood codes and standards.** Peacock, R.D. (National Bureau of Standards, Washington, DC). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The modernization of fire safety standards and codes affecting the use of wood as an alternate energy source is discussed. The available fire and explosion statistics, test methods, and model building codes were reviewed. Experimental studies to develop and quantify safe but reasonable limits for fire safety parameters were performed. (DC)

13751 (CONF-790987—, pp 43p, Paper 15) **Small scale wood combustion for space heating.** Hill, R.C. (Univ. of Maine, Orono). Dec 1979.

From DOE residue and waste fuels utilization program contractor review meeting; Washington, DC, USA (25 Sep 1979).

The development of a 100,000 Btu/h stick-wood fired furnace complete with water heat exchanger and storage tank has been completed. About twenty units are now in operation. Three companies are contracting with the University for commercial development. the work has been completed - a final report is in process.

13752 (DOE/AD/6038—1) **Multiprogram laboratory general purpose facilities studies: an approach to bringing institutional facilities to a level of adequacy consistent with DOE missions.** (Hayes, Seay, Mattern and Mattern, Roanoke, VA (USA)). Dec 1979. Contract EW-78-C-05-6038. 189p. Dep. NTIS, PC A09/MF A01.

The planning effort is concerned with facilities, i.e., the buildings, utilities, and roads, of DOE's multiprogram laboratories. An analysis of the needs of the DOE mission and program tested against the ability of the existing physical plants to accommodate those needs constitutes the basis of the effort. For each deficiency identified, solutions have been formulated as capital construction projects. Solutions which can be effected through maintenance and repair expenditures are the responsibility of each installation director and are not included herein. Management of facilities is a comprehensive process which includes organizational responsibilities, budget techniques, construction, operation and maintenance, site planning, and other similar functions. This document represents a systematic approach to identifying solutions to the problems of existing facilities, a component part of the overall facilities management program. Ten DOE multiprogram laboratories are addressed in the plan.

13753 (NTIS/PS—79/0593) **Heat loss detection of buildings (a bibliography with abstracts). Report for 1964-May 1979.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, VA (USA)). Jun 1979. 71p. NTIS PC N01/MF N01.

The citations in this bibliography describe various methods for displaying or determining heat loss in residential buildings, commercial buildings, and house trailers. These methods disclose sources of heat loss such as structural defects, moisture spots, and other anomalies in building envelopes. Thermography, infrared detection, tracer gases, time-response methods, and statistical predictions are among the methods used for heat loss determination. (This updated bibliography contains 63 abstracts, 23 of which are new entries to the previous edition.)

13754 (ORNL/CSD—52) **One aspect of the statistical evaluation of a computer model.** Bowman, K.O. (Union Carbide Corp., Oak Ridge, TN (USA). Computer Sciences Div.). Feb 1980. Contract W-7405-ENG-26. 90p. Dep. NTIS, PC A05/MF A01.

The motivation for this research is the need of DOE (and others) for methods and procedures to be used in validating large-scale computational models. Consider a typical example of an energy model developed to predict residential usage at some time t in the future. The problem is to quantify the uncertainty in the prediction. In this example only 109 of the parameters were considered to have non-negligible uncertainty, and standard deviations for these 109 could be assessed. Fifty Monte Carlo runs of the model were made, and the skewness and kurtosis statistics (roo' b_1 and b_2) of the resulting empirical distribution calculated. With these and the results of research on their bivariate distribution, the approximate form of the distribution could be identified (Pearson Type I distribution), and from it, the 75% probability regions on the statistics computed. The extremes on the probability region identify extremes of the family of Pearson Type I distributions. A percentile (say the 95th) can be picked off each of the extreme distributions, and thus identify an

interval for energy usage. Thus, one can say that there is 75% certainty that 95% of energy usage predictions will be less than some number in the interval. Background theoretical material for the basic statistical methodology is described in the appendixes.

13755 (PB—290777) **Guidelines for adjustment of atmospheric gas burners for residential and commercial space heating and water heating. Final report, September 1977—December 1978.** DeWerth, D.W.; Himmel, R.L.; Locklin, D.W. (Battelle Columbus Labs., OH (USA)). Feb 1979. Contract EPA-68-02-2653. 35p. NTIS, PC A03/MF A01.

The guidelines contain recommended procedures for adjusting residential and commercial atmospheric gas burners used for space heating and water heating to minimize air pollution and for efficient use of fuel. They are intended for use by skilled service technicians in adjusting burners, and as a aid to service managers engaged in training service technicians. In addition to recommended steps for burner adjustment, the guidelines also include appendixes of background material on pollutants of main concern, field-type instruments and significance of measurements, and emission characteristics of residential gas burners.

13756 (PB—294660) **Energy report: conductance, resistance and recommended standards. Technical memo (final).** (Albany County Planning Board, NY (USA)). May 1978. Contract HUD-D-11467. 19p. NTIS PC A02/MF A01.

This energy conservation report deals with calculations of a structure's conductivity and resistance, and delineates a method for calculating the cost of fuel used over the life of mechanical equipment and construction materials. It also presents minimum energy conservation standards for one, two, and multi-family residential construction.

13757 (PB—295338) **Economic evaluation of windows in buildings: methodology. Building science series.** Ruegg, R.T.; Chapman, R.E. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Apr 1979. 116p. NTIS PC A06/MF A01.

This study, which is one part of a National Bureau of Standards interdisciplinary project on windows, is aimed at improving the cost-effectiveness of window selection and use in buildings. It develops and illustrates a life-cycle costing evaluation model and computer program for assessing for alternative window systems the net dollar impact of acquisition, maintenance and repair, heating and cooling energy gains and losses, and artificial lighting and daylighting tradeoffs. The method is applicable to the evaluation of many different window sizes: designs, accessories, and uses, both for new and existing residential and commercial buildings. Two step-by-step examples of evaluating selected window alternatives in a residence and in an office building in Washington, DC. serve to illustrate the application of the method. A companion report, A Regional Economic Assessment of Selected Window Systems, presents the results of eight additional residential case studies and eight additional commercial case studies. While the emphasis of this report is on the method of evaluation, the companion report focuses on summarizing the results of a regional analysis in a form that will be convenient for use by building owners, operators, designers, financiers, and builders, those whose interest centers on the actual implementation of research results.

13758 (SAN—1693-1) **Assessment of proposed federal tax credits for residential wood burning equipment.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). 30 Nov 1979. Contract EC-77-C-03-1693. 212p. Dep. NTIS, PC A10/MF A01.

This report summarizes the results of a study of tax incentives for residential wood burning equipment. It presents an overview of the major issues affecting inclusion or exclusion of this equipment in the NEA tax credit program. The report was prepared as a quick response task within a six week period. Because of these time constraints, many simplifying assumptions had to be made in order to provide information in accordance with the decisionmaking schedule. The report is not meant to be considered as an exhaustive analysis of any particular issue area. (TFD)

13759 **Comparison of energy options: gas or electricity.** Harral, J.K.A.; Jones, M.R.; Hall, D.E. (Pacific Gas and Electric Co., San Francisco, CA). pp 33-42 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

Costs and efficiencies of gas and electric energy for representative types of residential appliances are compared. The comparisons are made using the 1976 operating and financial data of the Pacific Gas and Electric Co. and also for systems based on converting coal to gas and electricity and for liquefied natural gas (LNG). These analyses include discussions of efficiency, costs, and capital intensiveness. The efficiencies, to the point of energy delivery to the customer, apply to both industrial and residential users. On a more-limited basis, comparative analyses of several other gas and electric options are also presented. Finally, some discussion is devoted to water requirements for the production of substitute natural gas (SNG) and electricity and to tax considerations in the comparison of foreign and domestic energy supplies. For the systems and appliances studied, this analysis shows that: (1) gas, manufactured or natural, generally is or can be more efficient, less costly, and a less-capital-intensive form of energy than electricity for comparable uses when the total production through utilization system is considered; (2) capital required for new gas-supply systems is substantially less than the capital needed for comparable new electric systems; (3) other gas supplements such as LNG and SNG from naptha may be even more efficient, less costly, and less capital-intensive than SNG from coal and, therefore, appear even more advantageous when compared with electricity; (4) manufacture of gas generally consumes less water and requires less coal mining than the generation of electricity; and (5) the effect of domestic taxes should be considered when comparing foreign and domestic energy supply options.

OFFICE BUILDINGS

REFER ALSO TO CITATION(S) 13752

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 13752

13760 (AD-A—062929) **Energy audit pamphlet for installations. Final report.** Baum, P.E.; Hollis, H.D. (Army Facilities Engineering Support Agency, Fort Belvoir, VA (USA). Research and Technology Div.). 26 Apr 1978. 23p. NTIS, PC A02/MF A01.

This pamphlet provides guidelines and data forms to perform an energy audit of an installation and to assist in establishing installation energy usage data for the individual facilities of that installation. The pamphlet also describes how that data can be used to identify and rank possible energy conservation opportunities for the installation.

13761 (AD-A—062930) **Energy utilization survey pamphlet for buildings. Final report.** Baum, P.E.; Hollis, H.D. (Army Facilities Engineering Support Agency, Fort Belvoir, VA (USA). Research and Technology Div.). 26 Apr 1978. 41p. NTIS, PC A03/MF A01.

This pamphlet provides guidelines and forms to conduct an energy utilization survey of individual buildings and facilities on an installation. Forms are provided in this pamphlet for collection of information describing facility and individual building energy consumption. This information is needed to use energy conservation manuals which provide guidance on how to reduce and save energy through more effective operation of buildings and their mechanical and electrical systems, and through cost effective retrofit of existing systems. A list of these manuals is provided in Appendix A.

COMMERCIAL AND INDUSTRIAL BUILDINGS

REFER ALSO TO CITATION(S) 13753, 13755, 13757, 13759

TRANSPORTATION

REFER ALSO TO CITATION(S) 13737

13762 (COO—4649-8, pp 77-91) **Conventional power and propulsion.** Theoclitus, G.; London, A.L.; Yang, W.J. Oct 1979.

In Research workshop on energy conservation through enhanced heat transfer.

The status of, problems in recommendations for research on, and prospects for heat transfer augmentation in heat exchangers used in automobile, aircraft and ship propulsion systems are summarized. (LCL)

13763 (JACKFAU—78-159-2) **TEC model: transportation energy conservation model. Final report.** (Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA)). 16 Aug 1978. 167p. Dep. NTIS, PC A08/MF A01.

About one-third of all the energy consumed in the United States is burned by transportation vehicles, using 60% of all the petroleum that is consumed. The diversity and complexity of the total stock of transportation vehicles requires that meaningful analyses of conservation options must be based on sophisticated analytical capabilities. This report describes a computer-simulation model of transportation vehicles that provides such an analytical capability. Energy can be saved in transportation in several ways. Each trip that is taken could be made more efficient, which would generally lower the total number of trips taken. Trips that are of marginal usefulness can simply be eliminated. Finally, the fuel-consumption characteristics of the vehicles themselves can be altered to make them more

efficient. The Transportation Energy Conservation Model provides a capability for analyzing the effects of altering the fuel efficiencies of the various transport vehicles, and allows some capability for analyzing the effects of changes in the level of use.

13764 (PB—294839) **Bart's operating energy consumption. Working paper.** Sherret, A. (Metropolitan Transportation Commission, Berkeley, CA (USA); Peat, Marwick, Mitchell and Co., San Francisco, CA (USA)). Jan 1977. Contract DOT-OS-30176. 58p. NTIS PC A04/MF A01.

BART, the 71-mile Bay Area Rapid Transit System, serving San Francisco, Oakland, and other cities and communities, is the first regional-scale rapid transit system to open in the United States in over 50 years. Service began in 1972. This report is one of a series assessing the impact of BART on transportation and travel in the Bay Area. The report gives information on BART's operating energy consumption and incorporates an earlier BART Impact Program Report ('Analysis of BART's Energy Consumption for Interim System Operations', June 1975). The updated report was presented as a paper to the January 1977 annual meeting of the Transportation Research Board. It gives a historic analysis of BART's operating energy consumption per passenger-mile and per car-mile. BART's traction energy consumption is compared with that of (1) other rail transit systems, and (2) bus and automobile, in terms of equivalent gallons of petroleum fuel. BART's impacts on total energy consumed by BART, bus and automobile for transbay travel between San Francisco and Oakland is analyzed using data on travel patterns with and without BART. Although BART carries 20% of all passenger-trips in the transbay corridor, it has reduced overall energy consumption by only 5%. This saving is relatively small because, although BART consumes less energy per passenger-mile than automobile, it consumes more than bus. BART's ridership is drawn about equally from automobile and bus. BART has also had the effect of inducing new trips by automobile.

13765 (PB—296342) **Transportation Systems Center bibliography of technical reports. Report for January-December, 1978.** Bilsback, J.A. (Raytheon Service Co., Burlington, MA (USA)). Mar 1979. 133p. NTIS PC A07/MF A01.

The bibliography lists unlimited distribution reports released by the Transportation Systems Center from January through December 1978. It supplements the Transportation Systems Center Bibliography of Technical Reports, July 1970 - December 1976 (DOT-TSC-OST-77-17) and January - December 1977 (DOT-TSC-OST-78-14). Reports are listed by sponsoring agency, and are indexed by subject, personal author, corporate author, title, contract number and report number.

AIR AND AEROSPACE

REFER ALSO TO CITATION(S) 13768

13766 (AD-A—063789) **F-100 turbine engine afterburner emission tests. Final report, November 1976—December 1977.** Sousa, A.F.; Scott, H.A. Jr. (Scott Environmental Technology, Inc., Plumsteadville, PA (USA)). Sep 1978. Contract F08635-77-C-0216. 90p. NTIS, PC A05/MF A01.

The afterburner exhaust emissions from three F-100-P-100 engines were measured. Emission rates of hydrocarbons, carbon monoxide and oxides of nitrogen were calculated. Smoke numbers were also measured. (Author)

13767 (N—79-16850) **Energy efficient engine: propulsion system-aircraft integration evaluation. Topical report, March 1978 - September 1978.** Owens, R.E. (Pratt and Whitney Aircraft, East Hartford, CT (USA)). Mar 1979. Contract NAS3-20646. 311p. NTIS, PC A14/MF A01.

Flight performance and operating economics of future commercial transports utilizing the energy efficient engine were assessed as well as the probability of meeting NASA's goals for TSFC, DOC, noise, and emissions. Results of the initial propulsion systems aircraft integration evaluation presented include estimates of engine performance, predictions of fuel burns, operating costs of the flight propulsion system installed in seven selected advanced study commercial transports, estimates of noise and emissions, considerations of thrust growth, and the achievement-probability analysis.

RAILWAY

REFER ALSO TO CITATION(S) 13780

13768 (CONF-7904105—, pp 443-448) **Alternate energy sources for non-highway transportation.** Cart, E.N. Jr. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The overall objectives for the study were to examine the choices for alternate fuels in each mode - aircraft, marine, railroad, and pipeline for the present (now-1985), mid-term (1985-2000), and long-term (2000+), and to recommend R & D ideas for each mode. The paper summarizes a preliminary screening step where many different types of prime movers and fuels were evaluated, an evaluation for each mode. (TFD)

13769 **System Al_2O_3-P_2O_5-H_2O at 200°C.** Feng, S.S.; Rockett, T.J. (Univ. of Rhode Island, Kingston). *J. Am. Ceram. Soc.;* **62**: No. 7-8, 430-431(Jul 1979).

The study of the system Al_2O_3-P_2O_5-H_2O was made as part of an effort to determine if aluminophospate cements can be used under geothermal conditions. The system is also of interest because of phosphate-bonded refractories, crystal growth of the piezoelectric, berlinite, and for its mineralogic significance.

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 13824

13770 (DOE/R5/10157—1) **Semi-annual progress report on the electric moped.** Ferschl, M.S. (Department of Energy, Washington, DC (USA)). 27 Dec 1979. Contract FG02-79R510157. 14p. Dep. NTIS, PC A02/MF A01.

Progress in developing the design and performance testing of two electrically-powered moped's, one with a 1 HP motor and 12 volt battery and the other with a 1 1/4 HP motor and a 24-volt electrical system, is reported. The design phase is nearing completion. (LCL)

13771 (PB—292255) **Technological change in U.S. automobile industry: assessing past federal initiatives. Final report, June 1977-May 1978.** Abernathy, W.J.; Chakravarthy, B.S. (Lexington Technology Associates, MA (USA)). Jan 1979. Contract DOT-TSC-1355. 102p. NTIS, PC A06/MF A01.

In the future, further reductions in fatalities, fuel consumption and emissions due to automobile use will be needed. To insure that these goals are achieved, it is necessary to understand more thoroughly the role of Federal initiatives and regulation in encouraging the development, implementation and adoption of innovative automobile technology. The study provides an important link in addressing these questions. It examines the pattern of past Federal initiatives in the automobile industry and the effect of those initiatives on innovation. In addition, a framework is developed for assessing the joint consequences of Federal technology creation and market pull initiatives on the diffusion process.

13772 (PB—295106) **Modification and evaluation of a small station wagon designed for transportation of the handicapped. Final report.** Forest, J.; Versailles, C.A. (Minibus Forest, Inc., Montreal, Quebec (Canada); Centre de Recherche et de Developpement Transports Canada, Montreal, Quebec). Jun 1978. 40p. NTIS PC A03/MF A01.

The project was designed to modify and evaluate a small stationwagon to be used to transport handicapped people in a door-to-door service. The project made it possible to determine specific data in terms of future modifications. The report concludes that: (1) the project shows that a small modified stationwagon can be used to transport handicapped people and provide both a useful and viable service; (2) the prototype evaluated has the required size, capacity, comfort, and versatility; and (3) the cost of modification, the weight and gas consumption could be substantially reduced if these vehicles were modified en masse, because that would justify using a fiberglass body rather than a steel one.

13773 (PB—295310) **Replacing government sedans yearly would result in fuel and cost savings.** (General Accounting Office, Washington, DC (USA). Logistics and Communications Div.). 8 May 1979. 37p. NTIS PC A03/MF A01.

This report discusses the potential for savings if the General Services Administration replaced its sedans annually instead of every 6 years.

13774 (PB—295339) **Investigation of the requested alternate dynamometer power absorption for the Ford Fiesta. Technical report.** Thompson, G.D. (Environmental Protection Agency, Ann Arbor, MI (USA)). Mar 1978. 17p. NTIS PC A02/MF A01.

Concern about the EPA fuel economy measurements has focused greater attention on the dynamometer and the dynamometer adjustment. Specifically the alternate procedures for determining the dynamometer power absorption to simulate the vehicle road experience affords an opportunity for both greater precision and possible abuse. Because of the possibility for abuse it was decided to occasionally check the appropriateness of the alternate dynamometer power absorptions requested by vehicle manufacturers. The question of the representativeness of the requested dynamometer power absorption for the Ford Fiesta was first raised during the summer of 1977. This report collects and summarizes the pertinent available data which have been generated by the EPA Emission Control Technology Division, the EPA Certification Division, and by Ford Motor Company.

13775 (PB—295340) **Investigation of the requested alternate dynamometer power absorption for the Ford Mercury Marquis. Technical report.** Thompson, G.D. (Environmental Protection Agency, Ann Arbor, MI (USA)). Mar 1978. 34p. NTIS PC A03/MF A01.

Concern about the EPA fuel economy measurements has focused greater attention on the dynamometer and the dynamometer adjustment. Specifically the alternate procedures for determining the dynamometer power absorption to simulate the vehicle road experience affords an opportunity for both greater precision and possible abuse. Because of the possibility for abuse it was decided to occasionally check the appropriateness of the alternate dynamometer power absorptions requested by vehicle manufacturers. The question of the representativeness of the requested dynamometer power absorption for the Mercury Marquis was first raised during the summer of 1977. This report collects and summarizes the pertinent available data which have been generated by the EPA Emission Control Technology Division, the EPA Certification Division, and by Ford Motor Company.

13776 (PB—295349) **Transportation systems management element. Final report.** Sterman, L.; Schold, S.; Ferris, B. (East-West Gateway Coordinating Council, St. Louis, MO (USA)). Mar 1979. 112p. NTIS PC A06/MF A01.

Transportation Systems Management (TSM) denotes a process designed to increase the efficiency of existing transportation facilities and resources by implementing low-capital measures which reduce the need for major capital improvements. In addition to fiscal economy, the TSM process insures that meaningful steps can be taken toward attaining broader local and national goals, which include: energy conservation; environmental improvements; equity for transit dependents; and urban preservation. Several factors strongly influence the conception of the TSM planning process. First, TSM must be an integral part of some overall scheme or approach to transportation planning in the region. Second, in order to be successful, TSM planning must conform to a key set of attributes or requirements. Third, and most important, the process must effectively generate results, because the process itself is not the end product. TSM planning must produce projects designed to meet preconceived goals and objectives in the most cost-effective and publicly acceptable manner. This report documents the TSM planning process in the St. Louis, Missouri region, and includes TSM goals and objectives, planning programs, projects and concepts, and project monitoring.

13777 (PB—295417) **Energy use and conservation in highway construction and maintenance. Final report.** Halstead, W.J. (Virginia Highway and Transportation Research Council, Charlottesville (USA)). May 1978. 60p. NTIS PC A04/MF A01.

The report reviews options for conservation of energy in highway construction and maintenance. Objectives to conserve energy were found to relate closely to objectives of conserving high quality materials and to reduce costs. For overall energy efficiency the best possible construction and maintenance procedures, consistent with budgetary limitations and availability of materials, is considered desirable. Major conclusions are: no major changes from present-day construction practices are needed, energy considerations should be a factor in planning and conducting research in all technological areas, best potential for conserving energy in construction are increased use of mineral wastes and local materials; increased recycling for both asphalt and concrete pavements; substitution of emulsions for cutback asphalts, and because of possibility of reduced asphalt supply in the future, long range studies for minimizing use of asphalt in highways are recommended.

13778 (PB—295475) **Paratransit vehicle test and evaluation. Volume I: ride comfort and quality tests. Final report, November 1976-August 1977.** Wesson, L.; Culley, C.; Anderson, R.L. (Dynamic Science, Inc., Phoenix, AZ (USA)). Jun 1978. Contract DOT-TSC-1241. 216p. NTIS PC A10/MF A01.

The vehicles presently available for paratransit service do not cover the full spectrum of required characteristics necessary for public transportation. Therefore, specifications were developed by the U.S. Government for a vehicle specifically for use in paratransit service. Prototype vehicles were manufactured for the Government by two different manufacturers, and independent series of tests and evaluations of these vehicles were conducted. The program was structured to provide performance data that will be used to upgrade future redesigns. The program consisted of five separate test series: (1) Ride Comfort and Quality; (2) Acceleration and Interior Measurement; (3) Handling; (4) Fuel Economy; and (5) Noise. The results of the program are documented in a five-volume technical report, and each volume corresponds to one of the individual test series. This volume (Volume I) presents the test procedures and results of the ride comfort and quality test series. The objectives of this test series were to measure the ride characteristics of the test vehicles and to determine if and how well they satisfied standards for ride quality. The tests measured the ride characteristics of the two prototype vehicles and a baseline passenger car as they were driven at controlled speeds over a specially constructed ride course. The vibratory motions impacted to the driver and passengers were evaluated against the criteria in International Standard ISO 2631 for driver fatigue and passenger comfort.

13779 (PB—295478) **Paratransit vehicle test and evaluation. Volume IV: Fuel economy tests. Final report, November 1976-July 1977.** Wesson, L.; Culley, C.; Anderson, R.L. (Dynamic Science, Inc., Phoenix, AZ (USA)). Jun 1978. Contract DOT-TSC-1241. 51p. NTIS PC A04/MF A01.

A series of tests and evaluations of two prototype vehicles for paratransit were conducted. This volume (Volume IV) presents the test procedures and results of the fuel economy tests. The test series determined the fuel economy of the vehicles as they were driven through simulated urban and suburban driving cycles. The relationships between fuel consumption and vehicle speeds were determined and maximum fuel economies were established.

13780 (PB—295994) **The transportation corridor in northwest Indiana. Final report.** Shlay, D.; Gil, H.; Mullins, C.J. (Indiana Univ., Bloomington (USA). Inst. for Urban Transportation). Jul 1978. 232p. NTIS PC A11/MF A01.

The report describes a study of passenger transportation service in Northwestern Indiana South Bend to Chicago. The objective of the study was to determine the appropriate transportation service that would meet the travel needs of the residents of Northwestern Indiana including St. Joseph, La Porte, Porter and Lake counties. The transportation corridor is defined by existing public transportation and highway facilities in the area from South Bend, Indiana, to Chicago, Illinois. A summary of the history of commuter transportation in the corridor is presented herein. Estimates of the number of railroad and other trips that would be made in the corridor in 1980, 1990, and the year 2000 are made. Nine options for providing commuter transportation in the corridor were presented and evaluated in the terms of environmental criteria, quality of service, economic and financial factors, and special factors. The study recommends that the Chicago, South Shore and South Bend passenger service be continued. The study found that the South Shore is the most energy efficient, the safest, and fastest, and the least costly mode of commuter transportation in the corridor. In addition, it does not increase the congestion of highways or parking problems in downtown Chicago. It has positive economic effects on and is essential to the efforts to decrease air pollution in the heavily industrialized area. Finally, the study found that the continuation of the South Shore would have positive effects on recreation at the National Lakeshore Park and the proposed multimodal terminal at St. Joseph County airport.

13781 (PB—297756) **Ranking tires using a transient speed-time cycle. Technical report.** Burgeson, R.N. (Environmental Protection Agency, Ann Arbor, MI (USA)). Mar 1979. 19p. NTIS, PC A02/MF A01.

The ability to rank passenger car tires according to their respective rolling resistance facilitates emission and fuel economy testing and can serve as a consumer buying aid. However, at the present time a single, universally accepted tire rolling resistance measurement method is not available. Current practices measure rolling resistance while the tire operated at steady state conditions which are a typical of actual tire use. Emission Control Technology Division is concerned that tires ranked according to typical steady state practices perform differently when operated according to current emissions and fuel economy (transient) tests or in real life. This study was conducted to determine the difference in tire rolling resistance rankings from steady state and transient testing.

13782 (PB—297764) **Computer simulation of tire slip on a Clayton twin roll dynamometer. Technical report.** Yurko, J. (Environmental Protection Agency, Ann Arbor, MI (USA)). Feb 1979. 15p. NTIS, PC A02/MF A01.

Due to the occurrence of tire slip on a Clayton twin roll dynamometer, there is a difference between the velocities of the front and rear rolls of the dynamometer. This slip can be modeled by the method described in the following report. The results of this theoretically modeling show that, over the LA-4 and the HWFET driving schedules the velocity of the rear roll (which is currently used to determine the vehicle speed) exceeds the velocity of the front roll (which determines the power absorbed) by an average of approximately 1%. From this difference in velocities of the two rolls, a computation of the total energy effect, over transient driving cycles, can be obtained. Approximately a 2% to 5% increase in total energy dissipated over the city (LA-4) or highway driving schedules is predicted from the use of the front roll velocity to determine the vehicle speed, as compared to the currently used velocity of the rear roll.

13783 (PB—298173) **Tire rolling resistance measurements at initial inflation pressures of 45 psig and 26 psig. Technical report.** Burgeson, R.N. (Environmental Protection Agency, Ann Arbor, MI (USA)). 12 May 1978. 42p. NTIS, PC A03/MF A01.

A recent EPA Technical Report (1) presents the results of a program which relates tire rolling resistance measurements conducted on a Clayton twin small-roll dynamometer to those on a LABECO single large roll (48 in. diameter) dynamometer. The report extrapolates the results obtained on the LABECO to the road by the application of a curvature correction factor developed as a result of tire testing on both a flat surface machine and a large (67 in. diameter) roll dynamometer. This factor has been reported in the technical literature (2). In the EPA study, all tests were conducted at 45 PSIG cold inflation pressure which is the typical tire pressure used for emissions and fuel economy testing on the dynamometer. In order to determine the effect of tire pressure on rolling resistance, data were collected on the same tires used in the above study at a cold inflation pressure of 26 PSIG. These data were then combined with the 45 PSIG data for statistical comparison.

13784 (SAN—1095-T2) **Study on reduction of automotive accessory power requirements: final executive summary. Final report, June 1974-June 1978.** (AiResearch Mfg. Co., Phoenix, AZ (USA)). 20 Oct 1978. Contract EY-76-C-03-1095. 62p. Dep. NTIS, PC A04/MF A01.

This program was directed toward near-term automotive accessory optimization and toward evaluation of accessory systems for advanced Stirling and turbine automotive and truck propulsion engines. The objective was to define, evaluate and develop automotive accessory systems to minimize engine power consumption and significantly improve fuel economy. The program phases included: the conceptual, preliminary and detail design of automotive accessory systems and accessory drives; fabrication, assembly and laboratory testing of such systems and drives; vehicle/driving cycle energy source evaluation for accessory power augmentation, hybrid drive concept study, and an automotive air conditioning concept study for maximum required performance and minimum fuel consumption; and definition of automotive Stirling and gas turbine accessory requirements. Data from these studies are presented. It is concluded that equipping the 1979 US intermediate vehicle population with accessory speed control devices would conserve 69,000 bbl/d of fuel. If modified to take full advantage of energy reclamation and advanced accessory designs, the fuel savings could be as high as 150,000 bbl/d. If the entire US automotive population, with full accessory arrays, were equipped with accessory speed control devices, fuel conservation in the range of 180,000 to 400,000 bbl/d would be possible. The advanced accessory system technology discussed herein should be applied concurrently with new engine development to produce effective and efficient systems that maximize fuel economy potential. (LCL)

13785 (UMTA-LA—06-0002-79-1) **Taxi feeder to bus demonstration project in the St. Bernard Parish (Louisiana). Final report, June 1976-December 1978.** Ernst, U.F.W.; Miller, G.K. (Urban Mass Transportation Administration, Washington, DC (USA)). Aug 1979. 102p. NTIS.

The taxi feeder demonstration project in the St. Bernard Parish (Louisiana) began in June 1976 and ended in April 1979. It was designed to study the use of taxicabs as a convenient means of extending public transportation coverage at a relatively low cost per passenger. The service, in existence since 1974, offered residents of the suburb of New Orleans the option to use a taxi for the trip to or from the bus stop. The cost of this trip is included in a joint fare for the entire trip. The report describes the demonstration setting and the project evolution. The impact of taxi feeders on regular bus and taxicab services and costs as well as on ridership and revenues is presented. The applicability of the procedures developed in this project for other areas is also discussed.

SEA AND WATER

REFER ALSO TO CITATION(S) 13768

13786 (CONF-7904105—, pp 455-465) **Application of coal-oil fuels to marine steam and diesel propulsion systems.** Hansen, D.M. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The objectives of this study were to investigate in detail the technical and economic feasibility and the energy conservation potential of coal-oil and coke-oil mixtures for marine use, identify the additional research and development required for these fuels to constitute viable contingency fuels, and to develop a program plan for research and development. (TFD)

13787 (COO—4649-8, pp 93-113) **Nonconventional power and propulsion.** Rabas, T.J.; Holmes, R.; McEligot, D.M. Oct 1979.

In Research workshop on energy conservation through enhanced heat transfer.

The current status of, problem areas in, recommendations and prospects for heat transfer enhancement in heat exchangers used or planned for use with unconventional power systems, e.g., solar energy conversion geothermal energy conversion, and marine power plants are summarized. (LCL)

PIPELINE

REFER ALSO TO CITATION(S) 13768

INDUSTRY AND AGRICULTURE

ENERGY SOURCES

REFER ALSO TO CITATION(S) 13697, 13789

13788 (NCEI—0008) **Feasibility of using North Carolina peat for firing bricks.** Gay, B.M.; Paisley, M.J. (North Carolina State Univ., Raleigh (USA). Engineering Research Services Div.). Nov 1979. 29p. NTIS, PC A03/MF A01.

Peat has provided fuel for domestic heating, electric power generation and some industrial applications in several European countries for several years. However, the use of peat as a fuel source has just recently started to receive serious consideration in the United States. Eastern North Carolina has extensive peat deposits which, to date, have been unused as a fuel. The paper reports work undertaken to investigate the use of this peat resource as an alternate fuel in the firing of structural ceramics. It includes (1) the occurrence, availability, and properties of North Carolina peat, (2) laboratory firing and ashing characteristics, (3) comparison of properties of structural ceramics fired using peat in the laboratory with those fired using gas, and (4) economic considerations influencing the use of peat.

MATERIALS

13789 (COO—5011-5) **Sulfate specifications as a constraint to gypsum addition to cement and possible replacement of gypsum as an additive. Quarterly technical progress report, September-November 1979.** Kantro, D.L. (Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.). 1979. Contract EW-78-C-02-5011. 8p. Dep. NTIS, PC A02/MF A01.

If limitations on sulfate content in cements were made less restrictive, it should prove possible to use kiln fuels with higher sulfur contents and to employ energy-efficient modern preheater kiln technology without risk of exceeding sulfate specifications in the finished product. This would save energy and reserve low sulfur coal for more essential applications. In order to provide a basis for reconsidering the limitations currently imposed on sulfate contents in cements for reasons of soundness, comprehensive data are being developed in this research project on: potential alternatives to gypsum for controlling set in commercial concretes; additives to deter sulfate-induced expansion; and the influence of clinker manufacture on expansion potential in cements. The basic hydration characteristics common to the various mixtures of C_3A or C_4AF with calcium hydroxide and calcium and alkali sulfates have been delineated. X-ray diffraction analyses and free lime determinations for the various test clinkers have been completed. Drying shrinkage results have been obtained for the higher carbonate-content mortars previously described. The results indicate no adverse effect due to carbonate substitutions for up to 10% cement. (LLL)

13790 (DOE/ER—0040) **Methodology for assessing systems materials requirements.** Culver, D.H.; Teeter, R.R.; Jamieson, W.M. (Battelle Columbus Labs., OH (USA)). Jan 1980. Contract W-7405-ENG-92. 45p. Dep. NTIS, PC A03/MF A01.

A potential stumbling block to new system planning and design is imprecise, confusing, or contradictory data regarding materials - their availability and costs. A methodology is now available that removes this barrier by minimizing uncertainties regarding materials availability. Using this methodology, a planner can assess materials requirements more quickly, at lower cost, and with much greater confidence in the results. Developed specifically for energy systems, its potential application is much broader. This methodology and examples of its use are discussed.

13791 (SAN—1257-T1) **Energy savings through the use of an improved aluminum reduction cell cathode. 1978 annual report.** Payne, J.R.; Dorward, R.C. (Kaiser Aluminium and Chemical Corp., Pleasanton, CA (USA)). May 1979. Contract EC-76-C-03-1257. 68p. Dep. NTIS, PC A04/MF A01.

Research which could result in a significant reduction in the energy required to produce aluminum is reported. The objectives of the program were to develop specifications for TiB_2 materials that have an acceptable life in an aluminum reduction cell; to develop cathode designs that can accommodate the inherent properties of the material; and to evaluate the process economics of an industrial retrofit. The materials evaluation program has established relationships between microstructure (grain size, porosity, etc.) and mechanical properties, and has distinguished those characteristics that

promote intergranular disintegration in a reduction cell. Methods have also been developed to inspect and detect defective material by nondestructive means. Heat transfer theory and experiments have been applied to the thermal shock problems. From this work it is concluded that: the primary failure mechanism observed in previous work no longer applies to dense TiB_2 parts that contain no grain boundary phases; thermal shock can be avoided by attention to TiB_2 shape design and heat up technique; and slow crack growth caused previous cell failures; and more cell testing is recommended. (LCL)

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 14009, 14034

13792 (ANL/OEPM—78-6) **Electrorefining of copper from a cuprous ion complexing electrolyte. I. Initial evaluation of potential for energy savings.** Brown, A.P.; Cook, G.M. (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 33p. Dep. NTIS, PC A03/MF A01.

On the basis of information available in the literature, the energy-saving potential of copper electrorefining with electrolytes in which cuprous ion complexes are stable was examined. Three alternative aqueous electrolyte systems were investigated: ammonia solutions, acid chloride solutions, and acetonitrile-sulfuric acid solutions. An energy saving of up to 75% under ideal conditions was predicted. Because of deficiencies present in the available literature, no definitive conclusions could be reached regarding the practical applicability of this energy-saving technology. A program of further experimental research is recommended.

13793 (COO—2861-2) **Evaluation of Monobeam test program.** (Loftus Furnace Co., Pittsburgh, PA (USA); Armco, Inc., Middletown, OH (USA); Kaiser Engineers, Inc., Chicago, IL (USA)). 14 Mar 1979. Contract EY-76-C-02-2861. 32p. Dep. NTIS, PC A03/MF A01.

The Monobeam is a mechanical device for transporting cold steel through a re-heating furnace for the purpose of bringing the cold steel up to a temperature where it can be hot worked through a rolling mill into strip or shapes. This is presently being done throughout the steel industry in pusher type furnaces and walking beam furnaces. The longitudinlly fired pusher furnace is less thermally efficient than the cross-fired walking beam furnace. The Monobeam furnace permits longitudinal firing, holds its insulation without maintenance during a furnace campaign, and was primarily invented as an energy-saving retrofit for existing pusher type furnaces. The program for testing and presenting an evaluation report for a prototype Monobeam unit at Armco's Middletown, Ohio, steel works is described. Test results are not included. This review concluded that the test program was professionally executed, and that data were properly recorded and analyzed. (LCL)

13794 (COO—4649-8, pp 47-56) **Chemical and process industries.** Foust, H.D.; Knudsen, J.; Loehrke, R. Oct 1979.

In Research workshop on energy conservation through enhanced heat transfer.

Present conditions, problem areas, recommendations, and prospects for future advances in heat transfer augmentation in equipment used in the chemical and process industries are summarized. (LCL)

13795 (COO—4649-8, pp 57-75) **Heat recovery.** Shah, R.K.; Bejan, A.; Rohsenow, W. Oct 1979.

In Research workshop on energy conservation through enhanced heat transfer.

Equipment and methods for augmenting the heat transfer performance of heat recovery equipment, problems related to such augmentation, recommendations for further improvements, and the potential of these augmented surfaces as industrial energy conservation equipment are summarized. (LCL)

13796 (EPRI-WS—78-134, pp 5.47-5.64) **Process measurement for energy management.** Flora, C.M. Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

Energy management requires precise measurements of a variety of fluid flows, such as fluid fuels, steam, and process liquids or gases, in order to be able to identify where energy can be conserved in a process. The criteria for selecting flowmeters for an energy management program and the design, operation, performance cost, and limitations orifice-type, turbine-type, and vortex shedding flowmeters are discussed. (LCL)

13797 (IDO—1570-T21) **State-of-the-art review of computer control in the steel industry.** Kusik, C.L.; Mounier, M.R.; Kucinkas, G.J. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jun 1979. Contract EY-76-C-07-1570. 99p. Dep. NTIS, PC A05/MF A01.

To develop and demonstrate cost-effective, energy-conserving programs, the Federal Government has implemented a cost-shared program with the iron and steel industry which, if successful, would significantly reduce the nation's dependence on all forms of energy, particularly on petroleum-based fuels. An appropriate Federal role is one of supporting development programs showing good potential of being economic, but not being funded by the private sector for various reasons, including (1) the risk of failure being such that the private sector will not undertake the work, and (2) benefits being so generally dispersed among different firms that no one private organization has sufficient incentive to fund the required research, development, and testing. This document provides the Department of Energy with a state-of-the-art assessment on computer control in the iron and steel industry and identifies program areas having energy-conservation potential by greater application of computer control. Program areas must be technically feasible, show a potential for energy conservation (especially scarce fuels), and be realistic in terms of ultimate application to a steel mill environment.

13798 (NBS-Handbook—124) **Energy management for furnaces, kilns, and ovens.** Wood, L.A.; Ward, J.F.; Kreider, K.G. (National Bureau of Standards, Washington, DC (USA). Office of Energy Conservation). Jan 1978. 46p. Dep. NTIS, PC A03/MF A01.

This handbook, part of the EPIC Energy Management Series, is directed to the user of direct fired heating equipment in light industry. Other publications in this series outline steps to plan and establish an energy conservation program in a business or industry. This handbook is a guide to making decisions as to just what actions are appropriate and effective for energy savings in equipment such as furnaces, kilns, and ovens. The major technique described is the heat balance. Examples of heat balances are used to identify energy losses on a batch furnace, a continuous paint dryer oven, and a slot forging furnace. Typical energy conservation opportunities in combustion control, insulation, etc. are discussed. Simplified methods of calculation and measurement are given. Benefit/cost analysis and the time required to recoup investment are described as means of evaluating energy-saving investments.

13799 (PB—290977) **Manufacturer's policies concerning average fuel economy standards. Final report, April—September 1977.** Whorf, R.P. (Whorf (Robert) and Associates, Elkins Park, PA (USA)). Jan 1979. Contract DOT-TS-13750. 67p. NTIS, PC A04/MF A01.

The form of regulation, i.e., the imposition of standards on the basis of each manufacturer's total production for a given model year, as well as the criteria to be applied by NHTSA in setting the 1981 through 1985 standards, require that very careful attention be given to understanding both the probable responses of each manufacturer and the economic and other consequences of such responses. The AFER (Average Fuel Economy Regulatory) Program at TSC is intended to assist NHTSA in the analysis of options for setting average fuel economy standards and applying the criteria of Title V of the Motor Vehicle Information and Cost Savings Act (Title III of EPCA) for an evaluation of these options.

13800 (PB—291826) **Assessing the results of the life cycle costing water heater experiment. Volume I: main report. Final report.** McEachron, N.B.; Hall, D.C.; Lewis, L.F. (SRI International, Menlo Park, CA (USA)). Sep 1977. Contract NBS-6-35757. 50p. NTIS, PC A03/MF A01.

This report presents an exploratory evaluation of the commercial impact of experiments using a life cycle costing (LCC) strategy in the procurement of water heaters; the experiments were conducted by the Federal Supply Service (FSS) and the Experimental Technology Incentives Program (ETIP). The purpose of the evaluation was to answer three questions: what was industry's response to the procurement by FSS, in terms of technological changes in water heaters supplied and subsequently commercialized; how appropriate have FSS methods been for measuring the value of these product changes to the government as user; and if the procurement strategy were altered in various ways, what would be the likely changes in these commercial impacts.

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 12943, 13676, 13819

13801 (AD-A—064288) **State of the art of devices for reducing energy losses from flue stack gases. Final report.** (Johns-Manville Sales Corp., Denver, CO (USA). Research and Development Center). 15 Jan 1979. Contract DAAK70-78-D-0002. 81p. NTIS, PC A05/MF A01.

The current state of the art for devices for saving energy that would be lost in flue stack gases has been evaluated by means of market and literature surveys. These surveys have included conversations with members of organizations known to have been involved in device evaluation programs. In addition many companies have worked as consultants to these organizations.

13802 (AD-A—069650) **Performance and evaluation of concepts and devices for heat reclamation from air conditioners, heat pumps, and refrigeration equipment. Final report.** Mohammadi, S.S.; Sloan,

E.D. (Colorado School of Mines, Golden (USA)). Aug 1978. Contract DAAK70-78-D-0002. 42p. NTIS, PC A03/MF A01.

A heat recovery system is described which uses air conditioner or heat pump waste heat for domestic water heating. Current commercial units and field test data are detailed with economic guidelines to aid in choice of a unit. This report enables the reader to determine the cost effectiveness of having such a unit installed. Safety, product warranty, and city and state coding restrictions are discussed. The current and future testing and demonstration plans are cited for the unit.

13803 (ORO—5623-T1) **Waste heat utilization project for the Paducah, Kentucky uranium enrichment gaseous diffusion plant. Volume II. Final report.** (Research Triangle Inst., Research Triangle Park, NC (USA); AiResearch Mfg. Co., Torrance, CA (USA)). 29 Sep 1978. Contract EC-77-C-05-5623. 227p. Dep. NTIS, PC A11/MF A01.

These appendixes to the report on waste heat utilization for the Paducah Gaseous Diffusion Plant contain information on the heat source and energy recovery systems; parametric studies of the power cycle and heat pump cycles; technological and economic feasibility studies of heat recovery systems and their components; improved power cycle and improved heat pump cycles; and the power plant feedwater preheating facility. It is concluded that in spite of high capital costs and limited thermal efficiency due to the low temperature of the heat source, a waste energy recovery system at the Paducah plant could save fuel and could probably generate energy at a competitive cost. Further detailed design studies for establishing accurate economic projections are recommended. (LCL)

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 12988, 12992, 13205, 13206, 13207, 13209, 13210, 13212, 13213, 13220, 13223, 13504, 13822

13804 (BM-RI—8377) **Regeneration and recycling of waste chromic acid-sulfuric acid etchants.** Soboroff, D.M.; Troyer, J.D.; Cochran, A.A. (Bureau of Mines, Rolla, MO (USA). Rolla Metallurgy Research Center). 1979. 13p. US Dept. of Interior, Pittsburg, PA.

Etchants containing hexavalent chromium and sulfuric acid are used in a variety of surface-finishing operations. When the resultant spent solutions are discarded, substantial quantities of chromium are lost and pollution problems are created. To minimize the undesirable environmental effects while improving metal and minerals recycling technology, the Bureau of Mines is conducting research on a method for the economic inplant recycling of these waste etchants. Trivalent chromium, produced when the etchant reacts with a substrate, is oxidized in the anode chamber of a diaphragm cell; other metals, dissolved during the etching operation, are transferred to the catholyte. When waste brass etchants are treated in this manner, all of the trivalent chromium is oxidized and more than 40% of the copper and zinc is removed. Similar copper removal and chromium oxidation are achieved with waste printed circuit board etchants and rinse waters from plastic etching operations. The electrical energy needed to regenerate 1 kg sodium dichromate is less than 9 kwhr. Regenerated brass etchants evaluated by two companies equaled or exceeded the performance of fresh etchants.

13805 (PB—295230) **A study of fluidized cathode cementation. Final report sep 77-jul 78.** Fisher, W.W. (Arizona Univ., Tucson (USA). Bureau of Geology and Mineral Technology). Jul 1978. 29p. NTIS PC A03/MF A01.

Copper recovery by fluidized cathode cementation on iron was studied in a laboratory scale rotating drum reactor using minus 325 mesh, spherical copper powder to form the fluidized cathode. The rate of cementation was found to be directly proportional to cupric ion concentration, precipitant surface area and fluidized cathode area. The activation energy for the process was found to be 5.26 kcal/mole. Granular activated carbon was shown to be effective as a fluidized cathode material.

13806 (PB—297283) **Water reuse and recycling. Volume I. Evaluation of needs and potential.** (Culp, Wesner, and Culp, Santa Ana, CA (USA)). Apr 1979. 197p. NTIS, PC A09/MF A01.

Estimates of the potential for waste water reuse and recycling in the United States in 1985 and 2000 are presented. Information developed by the U.S. Water Resources Council (WRC) for the Second National Water Assessment was used to supply the basic data for water supply, water needs and availability, and waste water discharges. Existing and proposed waste water reuse facilities are reported for each WRC Region. Water quality requirements are described for the following potential reusers of reclaimed waste water: agricultural irrigation, landscape irrigation, steam electric cooling, industrial cooling, and other industrial uses. Although the Nation's water supplies are generally sufficient to meet the requirements for all beneficial purposes, there are major water supply problems in most of the 21 regions and severe local problems in many of the 106 subregions. The purpose of the study for Volume 1 is to provide information on the potential for water reuse augmentation of future water supplies in the United States.

MUNICIPALITIES AND COMMUNITY SYSTEMS

13807 (ANL/CNSV-TM—25) **Heat-pump-centered integrated community energy systems.** Schaetzle, W.J.; Brett, C.E.; Seppanen, M.S. (Alabama Univ., University (USA). Bureau of Engineering Research). Dec 1979. Contract W-31-109-ENG-38. 283p. Dep. NTIS, PC A09/MF A01.

The heat-pump-centered integrated community energy system (HP-ICES) supplies district heating and cooling using heat pumps and a thermal energy storage system which is provided by nature in underground porous formations filled with water, i.e., aquifers. The energy is transported by a two-pipe system, one for warm water and one for cool water, between the aquifers and the controlled environments. Each energy module contains the controlled environments, an aquifer, wells for access to the aquifer, the two pipe water distribution system and water source heat pumps. The heat pumps upgrade the energy in the distribution system for use in the controlled environments. Economically, the system shows improvement on both energy usage and capital costs. The system saves over 60% of the energy required for resistance heating; saves over 30% of the energy required for most air-source heat pumps and saves over 60% of the energy required for gas, coal, or oil heating, when comparing to energy input required at the power plant for heat pump usage. The proposed system has been analyzed as demonstration projects for a downtown portion of Louisville, Kentucky, and a section of Fort Rucker, Alabama. The downtown Louisville demonstration project is tied directly to major buildings while the Fort Rucker demonstration project is tied to a dispersed subdivision of homes. The Louisville project shows a payback of approximately 3 y, while Fort Rucker is approximately 30 y. The primary difference is that at Fort Rucker new heat pumps are charged to the system. In Louisville, either new construction requiring heating and cooling systems or existing chillers are utilized. (LCL)

13808 (CONS—5007-T1) **Focus on energy conservation: a project list.** (Perkin-Elmer Corp., Pomona, CA (USA). Aerospace Div.). Apr 1978. Contract EC-77-C-01-5007. 135p. Dep. NTIS, PC A07/MF A01.

The Urban Land Institute (ULI) has prepared the following list of outstanding energy conserving projects for the US Department of Energy. As requested by the Department, the list includes descriptions of land developments and individual buildings suggested by members of ULI and by other sources. The projects have been selected to exemplify the major energy saving techniques in use today, with emphasis on those strategies most significant for people engaged in the business of land development. To make the list a useful reference for developers and public officials, ULI has attempted to cover energy conservation in the broadest sense from overall site planning to the functioning of individual building components. Focusing too closely on the myriad types of hardware available has been avoided and examples of the basic considerations important to energy-conscious planning and design are provided. Details on some heating, ventilation and air conditioning systems are provided in order to acquaint readers with major innovations in the field.

13809 (PB—292651) **Colorado motor vehicle emission inspection - a pilot program. Final report.** Liljedahl, D.R.; Terry, J.L. (Automotive Testing Labs., Inc., Aurora, CO (USA)). Mar 1978. Contract EPA-68-03-2593. 476p. NTIS, PC A21/MF A01.

The Inspection and Maintenance (I/M) Evaluation Task consisted of a series of emission and fuel economy tests on a sample of 1977 and 1978 passenger cars and thirty 1975-1978 model-year, light-duty trucks. This work was performed as an additional effort in the Denver portion of the EPA's FY77 Passenger Car Emission Factor Program. Tests were performed on the vehicles in their as-received condition. Many of these vehicles that failed an idle test during the initial test sequence were delivered to one of ten pre-selected repair and tune-up facilities in the east Denver area for corrective maintenance. Idle emission tests and maintenance actions were performed at the repair facilities before the vehicles were returned to the laboratory. These were followed by another series of tests at the laboratory to provide information on the effectiveness of the work performed. Two other tests were performed as part of the I/M program. An Induced Malperformance Idle Test, conducted with one spark plug disconnected, was performed on all the 1977 and 1978 passenger cars, all trucks and a sampling of 1975 and 1976 passenger cars. Thirty additional 1975 and 1976 model-year cars were also given a series of tests to evaluate the emission related performance of catalytic converters on vehicles with more than 50,000 accumulated miles.

CONSERVATION SERVICES

13810 (ANL/CNSV-TM—27) **Organizing for comprehensive community energy management planning: some preliminary observations.** Moore, J.L.; Berger, D.A.; Rubin, C.B.; Hutchinson, P.A. Sr. (Academy for Contemporary Problems, Columbus, OH (USA)). Dec 1979. Contract W-31-109-ENG-38. 62p. Dep. NTIS, PC A04/MF A01.

Many local governments have initiated programs to reduce energy consumption. Others are exploring local government's broader role in managing energy. The City Council in Portland, Oregon, has recently adopted the nation's most stringent local energy conservation program. Seventeen diverse communities varying in size from Janesville, Wisconsin (population 50,000) to Los Angeles, the nation's third largest city, are developing local energy management action plans as participants in the two-year Comprehensive Community Energy Management Program. This report provides an assessment of the organizing phase of the 17 communities. The report provides local officials and staff with information on the early lessons from the organizing phase. It also provides ANL and DOE with information useful to the development of the program. (MCW)

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 13020, 13023, 13676, 13820

13811 (AD-A—062653) **Technical evaluation study: engery recovery from solid waste at Fort Dix, NJ and nearby civilian communities. Final report.** Collishaw, A.N.; Hathaway, S.A. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Oct 1978. 57p. NTIS, PC A04/MF A01.

This study investigated the technical and economic feasibility of energy and materials recovery from solid waste presently landfilled at Fort Dix, NJ. The waste stream consists of conventional mixed solid waste generated at Fort Dix and adjacent McGuire Air Force Base(AFB). The available energy content of the waste stream is approximately 21.4 x 1,000,000 Btu/year from 18,600 tons/year mixed solid waste. Combining civilian waste from nearby communities with the military waste stream was considered. A total of 73,900 tons/year could be processed and the heat energy utilized.

13812 (ANL/CNSV-TM—23) **Heat pump centered integrated community energy systems: system development. Georgia Institute of Technology final report.** Wade, D.W.; Trammell, B.C.; Dixit, B.S.; McCurry, D.C.; Rindt, B.A. (Georgia Inst. of Tech., Atlanta (USA). Research Inst.; McCurry and Associates, Inc., Atlanta, GA (USA)). Dec 1979. Contract W-31-109-ENG-38. 422p. Dep. NTIS, PC A18/MF A01.

Heat Pump Centered-Integrated Community Energy Systems (HP-ICES) show the promise of utilizing low-grade thermal energy for low-quality energy requirements such as space heating and cooling. The Heat Pump - Wastewater Heat Recovery (HP-WHR) scheme is one approach to an HP-ICES that proposes to reclaim low-grade thermal energy from a community's wastewater effluent. This report develops the concept of an HP-WHR system, evaluates the potential performance and economics of such a system, and examines the potential for application. A thermodynamic performance analysis of a hypothetical system projects an overall system Coefficient of Performance (C.O.P.) of from 2.181 to 2.264 for waste-water temperatures varying from 50°F to 80°F. Primary energy source savings from the nationwide implementation of this system is projected to be 6.0 QUADS-fuel oil, or 8.5 QUADS - natural gas, or 29.7 QUADS - coal for the period 1980 to 2000, depending upon the type and mix of conventional space conditioning systems which could be displaced with the HP-WHR system. Site-specific HP-WHR system designs are presented for two application communities in Georgia. Performance analyses for these systems project annual cycle system C.O.P.'s of 2.049 and 2.519. Economic analysis on the basis of a life cycle cost comparison shows one site-specific system design to be cost competitive in the immediate market with conventional residential and light commercial HVAC systems. The second site-specific system design is shown through a similar economic analysis to be more costly than conventional systems due mainly to the current low energy costs for natural gas. It is anticipated that, as energy costs escalate, this HP-WHR system will also approach the threshold of economic viability.

13813 (ANL/CNSV-TM—24) **Heat-pump-centered integrated community energy systems. Final report.** Crane, R.E.; Werden, R.G. (Franklin Research Center, Philadelphia, PA (USA); Werden (R.G.) and Associates, Philadelphia, PA (USA)). Dec 1979. Contract W-31-109-ENG-38. 223p. Dep. NTIS, PC A10/MF A01.

Heat-pump-centered integrated community energy systems (HP-ICES) are energy systems for communities which provide heating, cooling and/or other thermal energy services through the use of heat pumps. Since heat pumps primarily transfer energy from existing and otherwise probably unused sources, rather than convert it from electrical or chemical to thermal form, HP-ICES offer significant potential for energy savings. By powering these heat pumps with nonscarce fuels, the use of which would be impractical in most conventional systems, less-abundant fuels including natural gas and oil can be conserved. Secondary benefits of HP-ICES include reduction of adverse environmental effects as compared to conventional systems, reliable production of services in contrast to the increasingly frequent utility curtailments and interruptions, and delivery of services to consumers at costs lower than those for conventional systems (including acquisition, operation, and maintenance costs). The objective of this multiphase HP-ICES project is development and demonstration of concepts leading to one or more operational systems by the end of 1984. The findings from the System Development Phase of the program are reported. Information is included on the HP-ICES concept; its application potential; variations in the basic HP-ICES concept which could lead to improved performance; applications of the concept to specific communities; design; economics; environmental impacts; and component testing requirements. (LCL)

13814 (COO—4531-9) **Beneficial use of rejected heat from electric power plants: summary final report.** Porter, R.W. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1979. Contract EC-77-S-02-4531. 17p. Dep. NTIS, PC A02/MF A01.

In situ beneficial use of rejected heat from steam-electric power plants is considered, wherein condenser coolant is used directly in the application without heat exchangers and wherein the relatively low temperatures are useful to the associated process. A major advantage of this approach is the maintenance of low turbine back pressure and high electrical-generating efficiency. The applications include direct discharge into a municipal water supply, interaction with wastewater treatment, and open-field irrigation. In each case, a thermal and economic systems analysis was performed and operational, legal, and other problems were assessed. In the case of the municipal water supply, the savings in cost of closed-cycle cooling and water-heater energy appear to offset operational problems in the water supply and may be sufficient to justify public acceptance. A number of more-advanced wastewater treatment processes would benefit from dilution with a portion of condenser discharge. The treated mixture would serve as makeup for a smaller modified closed-cycle cooling system and the balance would constitute a water product. Unfortunately, open-field irrigation does not seem feasible due to the large land areas requied. A number of supporting studies were performed in the area of interaction of cooling systems with the heat-power cycle, and in the area of spray-cooling systems which may be attractive in certain wastewater-treatment processes as well as for conventional closed-cycle and supplemental cooling of electric power plants.

13815 (COO—4977/1(Vol.1)) **District heating and cooling systems for communities through power plant retrofit distribution network. Volume 1. Executive summary final report, September 1, 1978-May 31, 1979.** (Public Service Electric and Gas Co., Newark, NJ (USA)). Oct 1979. Contract EM-78-C-02-4977. 40p. Dep. NTIS, PC A03/MF A01.

The technical-economic feasibility and environmental acceptability of a district heating and cooling system serving communities by retrofit of existing intermediate and base-load electric generating stations was studied. The study area was a densely populated area of New Jersey not being served by district heating. A range of powyr plant retrofit concepts were examined. Conceptual designs for retrofitting power plants for cogenerative operation (electricity and district heating/cooling) were developed. Innovative adaptations of existing technology were investigated that could make delivery of thermal services from central stations a reasonable investment for private capital. A market analysis was conducted to establish the extent and nature of the potyntial heating and cooling loads which are technically available within the proposed project areas. Potential for growth in thermal energy requirements was projected for each type of end-use consumer for periods ranging from 5 to 20 y beyond the study period. It was concluded from the phase I study that district heating/cooling has a market potential in areas with high density thermal loads; district heating offers greater near-term potential than cooling; hot water distribution systems would be best for heat transmission; the economics are marginally favorable; no legal, regulatory, nor environmental obstacles were found; and a more detailed study is justified.

13816 (COO—4979-1(Vol.1)) **District heating and cooling systems for communities through power plant retrofit and distribution network. Volume 1. Executive summary. Final report.** Watt, J.R.; Sommerfield, G.A. (Toledo Edison Co., OH (USA)). Aug 1979. Contract EM-78-C-02-4979. 16p. Dep. NTIS, PC A02/MF A01.

The potential service area for a district-heating system includes the existing downtown Toledo steam system and nine new customers. An alternative extends the system about ten city blocks to a large hospital now fueled with oil. The annual peak demands are estimated at 278.6 and 325.8 million Btu/hr., respectively. Retrofit schemes are similar for both service areas. A back-pressure turbine added in parallel with Toledo Edison's Acme Station No. 2 turbine

would provide steam at 250 psig. The plant's electrical output would decrease 18 and 23 MW for the two plans. Scarce fuel saved is estimated at 5.2 and 6.0 million gallons of No. 6 oil, respectively. Although no insurmountable barriers were apparent, the success of such a system is not guaranteed. Large base-load users must make long-term commitments to support the establishment of a system. Drawbacks to successful implementation include lack of incentive for potential customers to connect to the system due to an apparent abundant supply of natural gas; difficulty in financing due to the higher risk involved; reluctance of utility production services to narrow reserve margins caused by steam extraction; and the future uncertainties about environmental constraints on electric power plants.

13817 (COO—4979-1(Vol.2)) **District heating and cooling systems for communities through power-plant retrofit and distribution network. Volume 2. Tasks 1-3. Final report.** Watt, J.R.; Sommerfield, G.A. (Toledo Edison Co., OH (USA)). Aug 1979. Contract EM-78-C-02-4979. 251p. Dep. NTIS, PC A12/MF A01.

Each of the tasks is described separately: Task 1 - Demonstration Team; Task 2 - Identify Thermal Energy Source(s) and Potential Service Area(s); and Task 3 - Energy Market Analysis. The purpose of the project is to establish and implement measures in the downtown Toledo steam system for conserving scarce fuel supplies through cogeneration, by retrofit of existing base- or intermediate-loaded electric-generating plants to provide for central heating and cooling systems, with the ultimate purpose of applying the results to other communities. For Task 1, Toledo Edison Company has organized a Demonstration Team (Battelle Columbus Laboratories; Stone and Webster; Ohio Dept. of Energy; Public Utilities Commission of Ohio; Toledo Metropolitan Area Council of Governments; and Toledo Edison) that it hopes has the expertise to evaluate the technical, legal, economic, and marketing issues related to the utilization of by-product heat from power generation to supply district heating and cooling services. Task 2 gives a complete technical description of the candidate plant(s), its thermodynamic cycle, role in load dispatch, ownership, and location. It is concluded that the Toledo steam distribution system can be the starting point for developing a new district-heating system to serve an expanding market. Battelle is a member of the team employed as a subcontractor to complete the energy market analysis. The work is summarized in Task 3. (MCW)

13818 (NCEI—0011) **Design of an electronic module for electricity load research.** (Cain Encoder Co., Greenville, NC (USA)). 31 Dec 1979. 45p. Dep. NTIS, PC A03/MF A01.

A design is presented for a small solid-state module which permits load surveys and time-of-day billing from existing electric watthour meters without the problems of pulse-counting techniques or magnetic tape recorders. The Load Survey Module (LSM) obtains direct digital readings of the meter by interrogating a Cain Encoder at 15-min intervals and stores the successive four-digit readings in memory for later examination and computer entry via an LSM Reader also described. Each module can contain 4096 separate meter readings -- 42.7 days of readings -- without memory overflow. The very low combined power requirement of the LSM and the Cain Encoder allows the LSM to operate entirely from an internal long-life battery if desired. (Because of the latter feature the LSM and Cain Encoder are also useful for profiles of gas consumption). In addition, the LSM and Reader may be readily interfaced to telephone lines, power line carrier equipment or other communication or load management system with minimal investment. A system of LSMs will cost less and will give higher reliability, greater operating efficiency and convenience than a system of comparable size consisting of magnetic tape recorders and translators. Projected cost savings are shown and an estimate is given for the cost of developing a working prototype.

13819 (ORNL/SUB—7317/1) **Cogeneration feasibility study in the Gulf States Utilities service area.** (Stone and Webster Engineering Corp., New York (USA)). Dec 1979. Contract W-7405-ENG-26. 536p. Dep. NTIS, PC A23/MF A01.

Sites in the Gulf States Utilities service are considered for cogeneration feasibility studies. The sources of steam considered for the Orange, Texas and Geismar, Lake Charles, and North Baton Rouge, Louisiana sites include oil, coal, HTGR steamers, consolidated nuclear steam system, atmospheric fluidized-bed coal combustion, and coal gasification. Concepts concerning cogeneration fuel systems were categorized by technical applicability as: current technology (pulverized coal-fired boilers and fuel oil-fired boilers), advanced technology under development (HTGR steamers and the CNSS), and advanced technology for future development (atmospheric fluidized-bed boilers and coal gasification). In addition to providing data on cogeneration plant generally useful in the US, the study determined the technical and economic feasibility of steam and electric power cogeneration using coal and nuclear fuels for localized industrial complexes. Details on site selection, plant descriptions, cost estimates, economic analysis, and plant schedule and implementation. (MCW)

13820 (ORNL/SUB—7317/2) **Cogeneration institutional study in the Geismar, LA, and Orange, Texas areas.** (Stone and Webster Engineering Corp., New York (USA)). Dec 1978. Contract W-7405-ENG-26. 199p. Dep. NTIS, PC A09/MF A01.

The objective of this report is to provide a better understanding of the institutional problems involved in the use of coal-fueled cogeneration. The viewpoints of industry, utilities, and government were probed extensively through indepth confidential interviews. To provide a real-life basis for this investigation, two existing industrial sites in the Gulf Coast area were studied. The projected effects of the installation of coal-burning cogeneration plants supplying steam and electricity to several industries, replacing existing oil and gas burning boilers, were studied for each site. This report provides insights into the overall institutional problem that will be useful at other locations. It covers the regulatory, economic, financial, engineering, operating, contractual, and corporate relations aspects of cogeneration. It concludes with suggestions for future action by the Federal government, state governments, industries, and utilities that should be helpful in removing the institutional constraints that are retarding cogeneration installations and the use of coal.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 13213, 13519

13821 (DOE/TIC—11102) **Report of the Dutchess County Resource Recovery Task Force.** (Dutchess County Pyrolysis Project, Poughkeepsie, NY (USA)). Jan 1980. Contract EM-78-G-01-5143. 237p. Dep. NTIS, PC A11/MF A01.

In 1978, Dutchess County received a grant from DOE relating to the development of a resource-recovery system for the county. The program objectives were: (1) to recover energy-intensive materials; (2) to recover energy from the waste in the form of a medium-Btu fuel gas or other useful energy form; and (3) to effect a dramatic reduction in the quantity of solids to be disposed of in a landfill. Task I involved project management planning, including the assembling of a team and the development of a decision/milestone plan for implementation. Task II involved the confirmation of the conceptual design of a Union Carbide Purox pyrolysis facility. The study was to concentrate on siting of the facility, verification of waste quantities available for processing, and net processing costs based on current projected revenues versus facility construction and operating costs. A review of the work to the completion of the Task Force evaluation and recommendations made by the Dutchess County Resource Task Force are given. General recommendations for the proposed resource-recovery facility are to have: a sufficient and controlled waste stream, a recovered-energy customer, and a facility that is strategically located, reliable, and efficient. (MCW)

13822 (LA—8172-MS) **Overview of solid waste generation in the United States.** Lacombe, D.M. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 20p. Dep. NTIS, PC A02/MF A01.

Over 5 billion metric tons of solid waste was generated in the United States in 1977. Quantities, composition, and disposal techniques are discussed for the major waste categories: agricultural, mining and milling, industrial, municipal, energy production, and radioactive waste. Continued research and development of adequate disposal methods and resource recovery and recycling processes is needed.

EDUCATION AND PUBLIC RELATIONS

13823 (DOE/CS/5226—1) **Energy auditor training curriculum.** (American Inst. of Industrial Engineers, Norcross, GA). Oct 1979. Contract EM-78-C-01-5226. 124p. Dep. NTIS, PC A06/MF A01.

The curriculum presented is designed to be used by States in training energy auditors. The curriculum has been prepared to insure that participating individuals are technically competent to plan, implement, and follow-up energy audits. Successful completion of the program satisfies general-qualification requirements for an energy auditor. The core of the training curriculum is the logical sequence of steps that the energy auditor will be experiencing in conducting energy audits and the implementation and monitoring of a comprehensive energy-management program. (MCW)

13824 (DOE/IR—0055) **Consumer protection issues in energy: insulation, solar, automobile devices, home devices. A guide for attorneys general.** (Department of Energy, Washington, DC (USA). Office of Consumer Affairs). Sep 1979. 105p. Dep. NTIS, PC A06/MF A01.

This guide brings together current issues dealing with energy and consumer protection. Chapter I covers the insulation issue (description, consumer issues, Federal regulations and laws, state laws, industry self-regulation, examples of legal action, and contacts). Chapter II, covering the solar industry, presents discussions

on consumer issues, certification and product standards, building codes, and contacts, following a description of the issue. Subjects covered in Chapter III, Energy-Saving Devices for Automobiles, are air- (lean) bleed devices, vapor injectors, additives, Federal and state regulations, and contacts, following a description of that sector. Areas covered in Chapter IV on energy-saving devices for homes are wood-burning stoves, transient surge suppressors, water heater timers, and vent dampers, following the description of the issue. (MCW)

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

REFER ALSO TO CITATION(S) 13784

13825 (CONF-7904105—) **Highway vehicle systems contractors' coordination meeting. Sixteenth summary report.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Sep 1979. 644p. Dep. NTIS, PC A99/MF A01.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

Separate abstracts have been prepared for individual papers. (TFD)

13826 (CONF-7904105—, pp 1-4) **Alternative power systems and the environment.** Clusen, R.C. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The paper briefly reviews the programs for development of new and improved automotive power systems, such as diesel engines, gas turbines, Stirling engines, etc. Emphasis is placed on the environmental effects of the engines. (TFD)

13827 (CONF-7904105—, pp 416-427) **Controlled-Speed Accessory Drive (CSAD) Demonstration Program.** Courville, G.M. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The CSAD Evaluation and Demonstration Program consists of three phases: Phase I, Familiarization; Phase II, Pilot Test; and Phase III, Fleet Test. Phase I was completed in November 1978, and all of the planned objectives of Phase I were accomplished. The Phase II (Pilot Test) started in October 1978 and is planned to be completed by the end of April 1979. The objectives planned for Phase II are to: establish the final test procedure, standardize the test data sheets, standardize data recording procedures, write a computer program, formulate cost and installation procedures, and evaluate the on-the-road driving performance of 32 vehicles. The approach of Phase II is to use four pairs of matching vehicles at the following four selected locations: Boston, Massachusetts; Cape Kennedy, Florida; Dallas/Forth Worth, Texas; and Denver, Colorado. The eight vehicles will be monitored and data recorded. Four vehicles will have CSAD's installed and the other four will be standard production vehicles. All test vehicles will be used in the same operational manner as any other motor pool vehicle. Major intent of Phase II is to establish the criteria for the full-scale test program (Phase III).

INTERNAL COMBUSTION ENGINES

13828 (AED-Conf—78-268-005) **High-speed four-stroke gas engines.** Soellner, R. (Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Eggenstein-Leopoldshafen (Germany, F.R.)). 1978. 20p. (In German). (CONF-7809111—7). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 2. Essen heat pump meeting: drives for heat pumps; Essen, F.R. Germany (6 Sep 1978).

High-safety and long-living gas motors were developed in Jenbach from a construction series of fast-running diesel motors with 6, 8, 12, and 16 cylinders and a ratio bore: stroke of 135 to 145 mm, for use in water pump systems. Their most favorable operation speeds are between 750 and 1800 rev/min with a speed control region of 1:2. Average effective pressures of 7.6 bar are achieved in suction operation, when charging with air load cooling, pressure of 11.6 bar are obtained. The specific consumption numbers are lowest for natural gas operation; although they are higher for other gases used, the knock-sensitive fuels are however cheaper, so that it appears economical to make use of these. The emission of harmful substances in the exhaust gases corresponds approximately to limiting values specified in the USA for diesel vehicles which lie far below the limit values for the exhaust gases of locomotive motors specified by the International Railway Association. The slight noise produced simplifies the noise abatement within as well as outside the machine room. The temperature of the exhaust gases is within a favorable range for both full and partial load.

13829 (N—79-26221) **Experimental clean combustor program: diesel no. 2 fuel addendum, phase 3. Final report.** Gleason, C.C.; Bahr, D.W. (General Electric Co., Cincinnati, OH (USA)). May 1979. Contract NAS3-19736. 66p. NTIS, PC A04/MF A01.

A CF6-50 engine equipped with an advanced, low emission, double annular combustor was operated 4.8 hours with No. 2 diesel fuel. Fourteen steady-state operating conditions ranging from idle to full power were investigated. Engine/combustor performance and exhaust emissions were obtained and compared to JF-5 fueled test results. With one exception, fuel effects were very small and in agreement with previously obtained combustor test rig results. At high power operating condition, the two fuels produced virtually the same peak metal temperatures and exhaust emission levels. At low power operating conditions, where only the pilot stage was fueled, smoke levels tended to be significantly higher with No. 2 diesel fuel. Additional development of this combustor concept is needed in the areas of exit temperature distribution, engine fuel control, and exhaust emission levels before it can be considered for production engine use.

SPARK-IGNITION

REFER ALSO TO CITATION(S) 13881

13830 (COO—4493-5) **Improving the performance and fuel consumption of dual chamber stratified charge spark ignition engines.** Sorenson, S.C.; Pan, S.S.; Bruckbauer, J.J.; Gehrke, G.R. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). Sep 1979. Contract EC-77-S-02-4493. 294p. (UILU-ENG—79-4012). Dep. NTIS, PC A13/MF A01.

A combined experimental and theoretical investigation of the nature of the combustion processes in a dual chamber stratified charge spark ignition engine is described. This work concentrated on understanding the mixing process in the main chamber gases. A specially constructed single cylinder engine was used to both conduct experiments to study mixing effects and to obtain experimental data for the validation of the computer model which was constructed in the theoretical portion of the study. The test procedures are described. Studies were conducted on the effect of fuel injection timing on performance and emissions using the combination of orifice size and prechamber to main chamber flow rate ratio which gave the best overall compromise between emissions and performance. In general, fuel injection gave slightly higher oxides of nitrogen, but considerably lower hydrocarbon and carbon monoxide emissions than the carbureted form of the engine. Experiments with engine intake port redesign to promote swirl mixing indicated a substantial increase in the power output from the engine and, that an equivalent power levels, the nitric oxide emissions are approximately 30% lower with swirl in the main chamber than without swirl. The development of a computer simulation of the combustion process showed that a one-dimensional combustion model can be used to accurately predict trends in engine operation conditions and nitric oxide emissions even though the actual flame in the engine is not completely one-dimensional, and that a simple model for mixing of the main chamber and prechamber intake gases at the start of compression proved adequate to explain the effects of swirl, ignition timing, overall fuel air ratio, volumetric efficiency, and variations in prechamber air fuel ratio and fuel rate percentage on engine power and nitric oxide emissions. (LCL)

13831 (SAN—1865-T1) **Effects of microwaves on the performance of internal combustion engines. Final technical report, March 1, 1978-May 31, 1979.** Ward, M.A.V. (Combustion Electromagnetics, Inc., Lexington, MA (USA)). 30 Jun 1979. Contract ET-78-C-03-1865. 99p. Dep. NTIS, PC A05/MF A01.

The project studied the interaction of microwave energy with both an ignition plasma as well as with a hydrocarbon-air flame plasma in order to ultimately assist lean mixture burn and increase flame speed of a hydrocarbon-air fuel mixture in the internal combustion engine. In achieving these goals, vehicular exhaust pollutants will be reduced and engine efficiency will be increased.

DIESEL

REFER ALSO TO CITATION(S) 13839, 13871, 13873, 14160

13832 (CONF-7904105—, pp 310-331) **Diesel engine research and development status.** Roessler, W.U. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

A number of automobile manufacturers, Government agencies, and other organizations are currently involved in a variety of in-house and contracted programs in the areas of diesel engine technology and health effects. The current status of these programs is discussed. (TFD)

13833 (CONF-7904105—, pp 332-346) **DOE diesel particulate research plan.** Alexander, T.J. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The objectives of the diesel particulate research plan are: (1) to assess emission control technology and engine parameters that affect particulate formation; (2) to evaluate the health effects of diesel particulates, including chemical transformation and atmospheric phenomena that may modify health effects; (3) to assess the risk to the human population of increased diesel use, particularly the potential carcinogenicity of diesel exhaust; and (4) to better understand the basic combustion phenomena of the diesel (and other) engines. (TFD)

13834 (CONF-7904105—, pp 347-356) **Diesel Emissions Control Technology Project plan.** Willis, E.A. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The overall project plan as now envisioned consists of a four-year effort including three major project elements: (1) an annual assessment of diesel emissions control technology with emphasis on particulate emission control and measurement techniques; (2) experimental assessments of near-term particulate emissions reduction technology, primarily addressing external engine modifications, but also providing particulate samples for chemical characteristics evaluation by others; and experimental evaluation of diesel engine basic design variables and internal engine modifications which show promise of reducing gaseous and/or particulate emissions, while maintaining or improving fuel economy.

13835 (CONF-7904105—, pp 357-358) **Diesel engine panel discussion.** Johnson, J.H. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

13836 (CONF-7904105—, pp 386-401) **Diesel-organic-Rankine compound engine for long-haul trucks.** Doyle, E. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The purpose of this program is to develop and demonstrate a completely integrated compound engine, consisting of a diesel engine coupled to a Rankine engine, which operates on the exhaust heat from the diesel engine. This system is shown in outline in Figure 276. The prototype compound engine is built around a standard Mack Truck diesel engine, and the waste heat recovery system is a Thermo Electron organic-Rankine bottoming cycle system incorporating a turbine expander delivering power to the diesel engine drive train.

13837 (CONF-7904105—, pp 402-415) **Report on vehicle testing the Cummins turbocompound diesel engine.** Brands, M. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

Better utilization of wasted heat is the key to a more energy conserving and sociable diesel engine. As it is difficult to make practical use of the heat energy rejected to the engine coolant due to its relatively low temperature, redirection of this thermal energy into the exhaust has been the approach adopted. Here, by insulating the diesel engine combustion chamber, the available exhaust thermal energy will increase where the potential exists for waste heat recovery in an economical fashion. The turbocompound diesel engine is a suitable device for recovering this energy. The turbocompound engine employs a low pressure power turbine which further expands the exhaust gas. Turbine power generated is transferred back to the drive train by means of mechanically gearing the power turbine shaft to the rear of the engine crankshaft at a fixed ratio.

TURBINE

REFER ALSO TO CITATION(S) 13837

13838 (CONF-7904105—, pp 5-16) **Gas turbine designed for Army tank applications.** Laborde, J.J. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The AGT 1500 engine is the powerplant in the Army XM-1 main battle tank. That tank is entering low rate initial production. The first production vehicles will come off the production line in February 1980. The paper provides a brief description of the engine and the program which is in progress. Although this engine and vehicle are much larger in weight (60 tons) and power (1500 hp) compared with automotive requirements, it is a gas turbine engine in a heavy-duty vehicle which is entering a production mode. (TFD)

13839 (CONF-7904105—, pp 17-19) **Overview of DOE Heat Engine Program.** Brogan, J.J. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The paper briefly reviews the programs for developing the gas turbine engines, Stirling engines, and diesel engines. (TFD)

13840 (CONF-7904105—, pp 22-29) **Overview of Gas Turbine Systems Program.** Thur, G.M. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The programs for developing gas turbine engines for automotive propulsion systems are briefly reviewed. (TFD)

13841 (CONF-7904105—, pp 30-44) **Conceptual design study.** Wagner, C.E. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The Chrysler Improved Gas Turbine (IGT) Study was implemented as an add-on task to the Upgraded Engine Program and was principally defined as a study on improving the Upgraded Engine. Conceptional design and operation parameters of the engine are presented. (TFD)

13842 (CONF-7904105—, pp 45-64) **Conceptual design study.** Johnson, R.A. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

Working toward the same objectives as Chrysler, DDA and the Pontiac Motor Division of General Motors (GM) also carried out a conceptual design study for an improved automotive gas turbine powertrain. The objectives and baseline specifications are summarized. Of the six program objectives, thermal efficiency or fuel economy improvement was the single most important technical objective. The requirement for competitive cost, as always, carried importance second-to-none.

13843 (CONF-7904105—, pp 65-79) **Conceptual design study.** Howes, B.T. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The contract work began by considering nine variations of single-shaft engines and eight variations of free-power turbine engines. Each engine was ranked on a scale of 1 to 10 between a minimum acceptable value of ranking criteria and a maximum probable value. The ranking was determined judgmentally based on previous experience and studies available to both companies. The value of each ranking criteria was multiplied by a ranking importance factor with double importance assigned to fuel economy and manufacturing cost. (TFD)

13844 (CONF-7904105—, pp 80-111) **Conceptual design study.** Chapman, W.I. (Williams Research Corp., Walled Lake, MI). Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The investigation was divided into three tasks: Task I, IGT Powertrain Identification and Description; Task II, IGT Powertrain Analysis; Task III, IGT Vehicle Characterization. The prime objective of the IGT powertrain is a 20 percent improvement in powertrain thermal efficiency compared to a conventional 1976 powertrain, resulting in at least a 20 percent fuel economy improvement over the 1976 model year automotive vehicle on the EPA combined driving cycle. The powertrain must also meet an acceleration requirement of 0 to 97 km (0 to 60 mph) in 15.0 seconds. To achieve this acceleration with a 1542 kg (3400 lbm) vehicle requires a rated power in the 59.7 to 74.6 kW (80 to 100 hp) range. The steady-state power requirement is much lower than this, on the order of 15 kW at 89 km/hr (20 hp at 55 mph) or 26 kW at 113 km/hr (35 hp at 70 mph). (TFD)

13845 (CONF-7904105—, pp 112-121) **Panel discussion of gas turbine concept studies.** Bell, A. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

13846 (CONF-7904105—, pp 124-140) **Ceramic Applications in Turbine Engines (CATE).** Helms, H.E. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The objective of the CATE Program is to apply ceramic components in a highway vehicle gas turbine engine and, thus, reduce engine fuel consumption. Ceramic components permit increased engine operating temperatures which improve engine cycle efficiency. (TFD)

13847 (CONF-7904105—, pp 141-150) **Industry views on ceramic materials for automotive gas turbine applications.** Mann, D.L. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

In recent years, development of high-performance ceramic materials has progressed from the laboratory to production of hardware useful for the development of prototype gas turbine engines.

Emphasis is now being placed on process development to enhance lot-to-lot reproducibility and to provide improved properties in more massive, complex geometry components. Also, user designs and supplier choice of production methods are being influenced by the need for economical production of quantities representative of the turbine engine market. An assessment of the state-of-the-art in ceramic fabrication and the approaches being pursued to provide cost-effective components for turbine development are summarized. (TFD)

13848 (CONF-7904105—, pp 184-194) **Status of life prediction methodology for ceramics.** Lenoe, E.M. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The goals of the program are to: (1) fully explore statistical models for fast fracture; (2) define methodologies and their limitations for life predictions in various regimes of materials response; and (3) provide test data/empirical results/analytical comparisons to guide designers in choosing materials in regimes where methodologies are lacking.

13849 (CONF-7904105—, pp 195-200) **Status of Ford Program to develop ceramic regenerator.** Fucinari, C.A. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

In 1973, Ford determined, through a series of turbine engine tests, that chemical attack is one of the major causes of failure of ceramic regenerators. This chemical attack is caused by sodium which is ingested into the engine in the form of salt or from sulphuric acid which is formed in the products of combustion. The Alternate Automotive Power Systems Division of EPA joined Ford in 1974 in a joint program to develop chemically resistant ceramic heat exchangers. The program was transferred to ERDA in 1975 and then to DOE when it was formed. It is now under the technical direction of and partially supported by NASA. The ten major tasks in the current DOE/NASA Program are listed along with their objectives and current status. Most of the objectives have been surpassed. (TFD)

13850 (CONF-7904105—, pp 201-217) **Development of compliant foil air bearings for automotive gas turbines.** Gray, S. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The compliant hydrodynamic type of foil air journal has been in the DOE/Chrysler gas turbine engines and vehicles for approaching three years in a temperature environment of over 500°F and at a shaft speed of 58,500 rpm. Figure 157 shows the bearing location in the gas generator. The load and temperature capability has been demonstrated in that 150 hours of operation, and 700 start-stop cycles have been successfully achieved on specific bearings; other bearings have shown operating difficulties. The objectives of this limited investigation which started in October 1978 are to develop ways of extending the life and consistency of performance of the foil bearings and to make the reliability improvements available to the engines. (TFD)

13851 (CONF-7904105—, pp 367-369) **Greyhound/DOE Turbine-Powered Intercity Bus Demonstration Program.** MacKenzie, M.G. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

Greyhound Lines Inc. (GLI) and the US Department of Energy (DOE) have embarked on a comprehensive demonstration test program to evaluate a new, more promising design of Detroit Diesel Allison (DDA) gas turbine engines. These engines will be integrated with four heavy-duty intercity coaches which will operate in revenue service over routes mutually agreed upon by GLI and DOE. (TFD)

13852 (CONF-7904105—, pp 370-377) **Gas Turbine Transit Bus Demonstration Program.** Ross, R.J. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The objective of this program is to evaluate gas turbine engines in advanced design transit buses under actual service conditions. The goals are to: (1) acquire operational and engineering data; (2) determine benefits to transit properties; and (3) provide catalyst for engine commercialization. The expected near-term benefits are: (1) alternate fuels; (2) reduced emissions; (3) increased brake life; (4) elimination of engine cooling system; and (5) increased passenger comfort. The potential long-term benefits are expected to be: (1) fuel economy; and (2) reduced maintenance costs.

13853 (CONF-7904105—, pp 378-385) **Gas Turbine Engines and Transmissions for Coach Demonstration Programs.** Nigro, D.N. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

Detroit Diesel Allison (DDA) Division of General Motors is under contract to the Department of Energy, Division of Transportation Energy Conservation, Office of Highway Systems, to manufacture and deliver eleven GT404-4 gas turbine engines, five HT740CT automatic transmissions, and six V730CT automatic transmissions. The five GT404-4/HT/740CT power packages will be provided to Greyhound Corporation for coach integration and operation in the DOE-funded intercity coach demonstration program. The six GT404-4 engines and V730CT transmissions will be used in the parallel DOE/DOT-funded transit coach demonstration program. (TFD)

13854 (DOE/NASA/1040—79/9) **Performance sensitivity analysis of Department of Energy: Chrysler upgraded automotive gas turbine engine (S/N 5-4).** Johnsen, R.L. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1979. Contract EC-77-A-31-1040. 37p. (NASA-TM—79242). Dep. NTIS, PC A03/MF A01.

Performance sensitivities and interactions between gas turbine engine components were examined analytically when changes were made to several significant component performance and operating parameters. The gas turbine engine, a two-shaft configuration called the upgraded engine, was developed by the Chrysler Corporation under a US Department of Energy contract. The early upgraded engines had a serious power shortfall, and a cooperative effort was undertaken to remedy the problem. The performance sensitivity was examined for changes to several operating and component performance parameters. One change at a time was introduced, and the performance was calculated and then compared to the reference performance. This comparison was made at gas generator speeds from 50 (idle speed) to 100%. Sensitivities were determined for changes in turbomachinery efficiency, compressor inlet temperature, power turbine discharge temperature (which was actively controlled), regenerator effectiveness, regenerator drop, and several gas flow and heat leaks.As expected, the efficiency of the compressor and the turbines strongly affected performance. Compressor efficiency, which had the strongest effect on system performance, was closely followed by compressor-drive turbine and power turbine efficiencies. Efficiency changes to either the compressor or compressor-drive turbine efficiencies resulted in a shift in the operating point of the other two machines. For constant shaft speeds and power turbine discharge temperature, increasing the compressor efficiency resulted in reduced pressure ratio for the compressor-drive turbine and increased pressure ratio for the power turbine. Changes to power turbine efficiency did not affect the operating point of the other two machines. A tabulation of influence coefficients for several dependent variables is included for gas generator speeds from 50 to 100%.

EXTERNAL COMBUSTION ENGINES

STIRLING CYCLE

REFER ALSO TO CITATION(S) 13839

13855 (CONF-7904105—, pp 219-224) **Stirling Engine Project status.** Schulz, R.B. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The Stirling project objectives are to demonstrate propulsion systems in automobiles that: (1) achieve at least 30 percent higher fuel economy compared to the ICE of 1984; (2) are able to meet or better the most stringent Federal emissions standards proposed for the 1980's; (3) are capable of using a wide variety of combustible fluids as fuel; and (4) can be produced competitively. (TFD)

13856 (CONF-7904105—, pp 225-238) **MTI Automotive Stirling Engine Development Program.** Decker, O. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The final program objectives are to develop and demonstrate, by September 1984, an automotive Stirling engine system which, when installed in a 1984 vehicle, will meet the following goals: (1) 30% improvement in fuel economy over equivalent 1984 IC engine; (2) low exhaust emissions - HC/CO/NO/sub x/ = .41/3.4/.40 gram per mile; (3) ability to use alternative fuels; and (4) suitable for eventual commercialization.

13857 (CONF-7904105—, pp 239-261) **Automotive Stirling engine conceptual design study.** Sjostedt, L. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The conceptual design study is intended to guide component, subsystem, and engine system development. A reference engine system design will be generated and continually updated to reflect the best contemplated approaches and the latest technology to meet the final program objectives. The reference engine system will be the focal point to guide development, will be based on approved engine system concepts, and will include anticipated vehicle power level

and size for equivalent spark ignition, diesel, and stratified charge engine. (TFD)

13858 (CONF-7904105—, pp 262-272) **Stirling materials development.** Stephens, J.R. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The primary goal of the DOE/NASA Stirling Engine Project is to achieve a 30% fuel economy improvement over a 1983 spark ignition baseline engine. Based on recent fuel economy predictions for automotive Stirling engine systems, it has been postulated that an all-metal Stirling engine has the potential for meeting this goal. Accordingly, the materials technology program in support of the Stirling engine project has been reoriented to reflect this emphasis on an all-metal engine. Prior work initiated on ceramics for an advanced, high-temperature engine has been terminated. Current materials efforts are focused on the critical metallic components of the Stirling engine. They include valuation of the capability of current materials to meet Stirling engine requirements and the development of improved alloys with greater potential for cost-effectiveness in the automotive application. The materials effort is divided into three major areas which include materials characterization, development of improved materials, and fabrication technology. To date, research on metals has been confined to the first of these areas. Contract efforts in the second area are planned for the near future. As these programs mature and engine requirements are better defined, component fabrication technology will be addressed.

13859 (CONF-7904105—, pp 273-288) **Evaluation of reciprocating seals for Stirling cycle engine application.** Curulla, J. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The specific objectives of the program are first to review a number of rod seal designs to identify demonstrated or anticipated improvements over conventional O-rings for long life with minimal leakage under high wear conditions at elevated temperatures. The testing is conducted using a laboratory simulator to reproduce the rod action of the engine and to measure the friction forces at the rod/seal interface, seal wear resulting from use, and leakage in either direction across the seal. The results of this testing will provide either confirmation of seal adequacy as a part of the Stirling Cycle Engine System or valuable data that will assist in defining further research to develop an improved seal.

13860 (CONF-7904105—, pp 289-297) **Dynamic seals in Stirling engines.** Theeuwes, G.J.A.; Philips, N.V. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

13861 (CONF-7904105—, pp 298) **Panel discussion on Stirling Program.** Ragsdale, R.G. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

RANKINE CYCLE

REFER ALSO TO CITATION(S) 13836

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 13636

13862 (ANL/CNSV-TM—28) **Procedures for safe handling of off-gases from electric vehicle lead-acid batteries during overcharge.** LaBelle, S.J.; Bhattacharyya, M.H.; Loutfy, R.O.; Varma, R. (Argonne National Lab., IL (USA)). 25 Jan 1980. Contract W-31-109-ENG-38. 20p. Dep. NTIS, PC A02/MF A01.

The potential for generation of toxic gases from lead-acid batteries has long been recognized. Prior to the current interest in electric vehicles, there were no studies specificaly oriented to toxic gas release from traction batteries, however. As the Department of Energy Demonstration Project (in the Electric and Hybrid Vehicle Program) progresses, available data from past studies and parallel health effects programs must be digested into guidance to the drivers and maintenance personnel, tailored to their contact with electric vehicles. The basic aspects of lead-acid battery operation, vehicle use, and health effects of stibine and arsine to provide electric vehicle users with the information behind the judgment that vehicle operation and testing may proceed are presented. Specifically, it is concluded that stibine generation or arsine generation at rapid enough rates to induce acute toxic response is not at all likely. Procedures to guard against low-level exposure until more definitive data on ambient concentrations of the gases are collected are presented for both charging the batteries and driving the vehicles. A research plan to collect additional quantitative data from electric traction batteries is presented.

13863 (ANL/OEPM—78-11) **Research, development and demonstration of nickel-zinc batteries for electric vehicle propulsion. Annual report for 1978.** (Gould, Inc., Rolling Meadows, IL (USA). Gould Labs.). Oct 1979. Contract W-31-109-ENG-38. 143p. Dep. NTIS, PC A07/MF A01.

This is the first annual report describing progress in the 33-month cooperative program between Argonne National Laboratory and Gould Inc.'s Nickel-Zinc/Electric Vehicle Project. The purpose of the program is to demonstrate the technical and economic feasibility of the nickel-zinc battery for electric vehicle propulsion. The successful completion of the program will qualify the nickel-zinc battery for use in the Department of Energy's demonstration program under the auspices of Public Law 94-413.

13864 (DOE/CS—0130) **Electric and Hybrid Vehicle Program. 3rd annual report to congress for FY 1979.** (Department of Energy, Washington, DC (USA). Office of Transportation Programs). Jan 1980. 93p. Dep. NTIS, PC A05/MF A01.

The Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976 (P.L. 94-413) seeks to reduce petroleum consumption by encouraging the introduction and use of EHV and of hybrid vehicles. This third annual repot to the US Congress on the EHV Program summarizes activities during FY 1979, describing ongoing efforts, and recommending legislative action to facilitate further progress. The number of vehicles committed to market demonstrations increased from more than 200 in FY 1978 to almost 800 and demonstration sites rose from 16 to 57. There was a modest increase of commercial interest and public awareness of the potential of EHV also was heightened. Summaries are reported on market demonstrations, incentives, research and development, product engineering, commercialization activities, and legislative recommendations. (MCW)

13865 (DOE/NASA/1044—79/5) **Averaging battery model for a lead-acid battery operating in an electric car.** Bozek, J.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1979. Contract EC-77-A-31-1044. 20p. (NASA-TM—79321). Dep. NTIS, PC A02/MF A01.

Computer programs used to calculate the performance of an electric vehicle must contain a battery model. A simple mathematical model is developed and evaluated. The model is based on time averaged current or power required from a battery during the operation of the electric vehicle. The time averaging technique used accounts for time varying discharge rates, rest times, and the electrical regenerative braking that are normally experienced by a battery in an electric vehicle. The averaging battery model reported herein, has been verified through comparisons with test data gathered on batteries in the laboratory and from vehicles operated at test tracks. The averaging battery model accurately predicts the performance measured for lead-acid batteries operating in accordance with the power and current requirements of the various deriving schedules specified in the SAE Recommended Practice, Electric Vehicle Test Procedure - SAE J227a.

13866 (PB—290721) **Report of the committee on the steel industry study for the office of science and technology policy. Part I: role of research and development in the domestic steel industry. part ii. alternative uses for abandoned steel plants.** (National Materials Advisory Board (NRC), Washington, DC (USA)). Jul 1978. Contract ST8243. 53p. NTIS, PC A04/MF A01.

The report is an assessment of the current state of technology in the domestic steel industry with emphasis on research and development (R and D) associated with energy conservation, pollution abatement, and the role of the federal government in support of R and D. It reviews the causes of the present economic distress of the domestic steel industry and the reasons for the highly competitive position established by some foreign steel producers. One of the principal conclusions of this study is that any comprehensive federal program for improving the technological capability of the domestic steel industry must address the related problem of the financial health of the industry. Although research is an important component in the industry's technological base, an expanded R and D effort would have little immediate effect in improving the current economic status of the industry. Several specific R and D projects in process development, energy conservation, and pollution abatement are identified and recommended for government support, preferably under some cooperative industry-government arrangement. This study also addresses alternative uses of abandoned steel plants, with the conclusion that no general solution exists for the problem.

VEHICLE DESIGN FACTORS

ENGINE-TRANSMISSION MATCHING

13867 (CONF-7904105—, pp 428-434) **Transmissions: supporting research and technology.** Wood, J.C. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The transmission-supporting research and technology at the NASA Lewis Research Center is sponsored by DOE. The transmission work at NASA-Lewis had been managed by the Gas Turbine Project Office, but is now managed by the Vehicle Systems Project Office (VSPO) of the Power Generation and Storage Division in the Energy Programs Directorate. The objectives of the program are: VSPO: develop a supporting research and technology base for advanced transmissions; and DOT/TSC: obtain data base on performance of advanced prototype transmissions. The active projects reviewed include: (1) traction drive fatigue life testing; (2) traction contact performance tests; and (3) fixed-ratio traction drive engine tests. (TFD)

13868 (UCRL—15037) **Continuously variable transmissions: theory and practice.** Beachley, N.H.; Frank, A.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1979. Contract W-7405-ENG-48. 50p. Dep. NTIS, PC A03/MF A01.

The five basic principles that can be used in the design of continuously variable transmissions (CVT) for motor vehicles are examined and compared. These include: hydrostatic, traction drive (V-belt and rolling contact), overrunning clutch, electric, and multi-speed gearbox with slipping clutch. Appendix A discusses commercially available CVTs suitable for motor vehicles, and Appendix B describes research and development programs for CVTs.

EMISSION CONTROL

REFER ALSO TO CITATION(S) 13829, 13831, 14172

13869 (PB—292486) **Exhaust emissions from vehicles in demand-responsive service.** Gunderson, J.A. (Olson Labs., Inc., Anaheim, CA (USA)). Mar 1978. Contract EPA-68-03-2411. 158p. NTIS, PC A08/MF A01.

This report describes a study in which 11 1976 and 1977 demand-responsive service vehicles were tested to measure exhaust emissions. Each vehicle was exhaust emission tested using the FTP for Light-Duty Vehicles; the Surveillance Driving Sequence, including steady-state modes; and the AA-1 Urban Bus Cycle. Each vehicle was run at 'typical' inertia loads for all test procedures and 'fully loaded' for the AA-1 cycle. Emission data collected and reported will be used by the emission factors group of ECTD to estimate emissions inventories for this class of vehicles.

13870 (PB—292669) **Evaluation of restorative maintenance on 1977 light-duty vehicles in Denver, CO. Final report.** Liljedahl, D.R.; Terry, J. (Automotive Testing Labs., Inc., Aurora, CO (USA)). May 1978. Contract EPA-68-03-2408. 142p. NTIS, PC A07/MF A01.

Emission and fuel economy tests were performed on a sample of forty-two individually-owned 1977 model-year light-duty vehicles in the Denver metropolitan area. Vehicles manufactured by Chrysler Corporation, Ford Motor Company, and General Motors Corporation were represented somewhat equally. The purpose of these tests was to investigate emission and fuel economy performance of typical in-use passenger cars and to quantify the individual and combined effects of any observable defects, disablement and/or maladjustments on exhaust emissions and fuel economy.

PARTICULATES

13871 (PB—297572) **Particulate measurement - vehicle preconditioning. Technical report.** Danielson, E. (Environmental Protection Agency, Ann Arbor, MI (USA)). Feb 1979. 12p. NTIS, PC A02/MF A01.

A study has been made of the effects of different vehicle preconditioning on particulate emissions from three light-duty diesel automobiles. The results indicate that prior extreme operation of a vehicle can affect the level of particulate emitted during measurements by the Federal Test Procedure. However, one LA-4 driving cycle appears to provide adequate preconditioning for most cases. The duration and magnitude of the preconditioning effect varies among vehicles.

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 13206, 13786

13872 (CONF-7904105—, pp 435-441) **Evaluation of a hydrogen-fueled postal vehicle.** Hall, R.A. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

A jeep delivery vehicle has been modified to operate on hydrogen for the United States Postal Service (USPS). The objectives of this evaluation were to measure the vehicle fuel consumption and range over a postal driving cycle and fuel consumption and emissions over the 1975 urban driving cycle. (TFD)

13873 (CONF-7904105—, pp 449-454) **Alternate fuels for medium speed diesels.** Baker, Q. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The objectives of the program were: (1) determine the effect of variations in pertinent diesel fuel properties on fuel consumption, combustion characteristics, piston ring wear, and exhaust emissions for a medium-speed diesel engine; (2) define the envelope of diesel fuel properties that permit acceptable engine operation in terms of these parameters; (3) determine the performance, wear, and emissions characteristics of a medium-speed diesel engine operating on methanol and a simulated coal-derived fuel; (4) define the degree to which diesel fuel can be replaced by methanol and simulated coal-derived liquid as primary engine fuel; and (5) prepare a program plan for the future investigation of alternate fuels for this class of engines. (TFD)

13874 (CONF-7904105—, pp 467-470) **Overview of projects on new hydrocarbons and synfuels.** Fleming, R.D. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The strategy for attaining the Alternative Fuels Utilization Program goal in relation to synthetic gasoline and diesel fuels for highway vehicles is to determine the consequences of the use of synthetic gasoline and diesel fuels in current and improved engines. The strategy includes evaluation of engine performance, efficiency, and emissions. Emissions include not only regulated emissions, but unregulated emissions such as polynuclear aromatic hydrocarbons that are due to the aromatic nature of the fuel. Assessments need to be made in relation to the hazards of unregulated emissions such as polynuclear aromatic hydrocarbons. Also included in the strategy is the evaluation of fuel characteristics and assessment of abnormalities and possible needs for correction.

13875 (CONF-7904105—, pp 471-473) **Potential for improving short trip fuel economy by fuel formulation.** Marshall, W.F. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

An experimental investigation was undertaken to determine the influences of fuel characteristics on fuel economy penalty incurred in short trips and in operating vehicles at other than normal temperatures. The overall objective was to determine the potential benefits of fuel reformulation to minimize fuel economy penalty associated with cold-start, warm-up operation. Vehicle tests were conducted in a chassis dynamometer facility at test temperatures of 20° and 90°F. Fuels used were gasoline and natural gas. Figure 348 shows the results of the SI vehicle tests with gasoline and natural gas and the diesel tests in terms of energy consumed versus miles driven. The minimum penalty to economy was defined as that corresponding to operation with natural gas because its use obviated necessity for engine choking and enrichment during cold-start and warm-up. Results indicate use of natural gas resulted in energy savings of 15% in a five-mile trip at 20°F ambient; this was due to changes in choke schedule and mixture stoichiometry which were made possible by use of the gaseous fuel. However, nearly the same improvement could also be achieved with gasoline by closer control and modulation of choke, enrichment, and main fuel metering systems. (TFD)

13876 (CONF-7904105—, pp 475-478) **Overview of Federal Alcohol Fuels Program.** Ecklund, E.E. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The development and use of alcohol fuels are discussed with emphasis on tax incentives, guaranteed loans, and exhaust emissions. (TFD)

13877 (CONF-7904105—, pp 479-485) **DOE Reliability Fleet Test Program for Alcohol/Gasoline Fuels.** White, H.M. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The use of alcohol/gasoline blends in SI internal combustion engines has progressed through assessment and evaluation studies, with problem solving due to be completed during the current fiscal year. The next sequential step is the demonstration of commercial readiness for these fuels through the successful accomplishment of large-scale reliability fleet testing. The objectives of this test program are to: (1) demonstrate the commercial readiness of 10-vol% alcohol/gasoline blends in highway vehicles; (2) establish reliability and performance data base for in-service operation under wide spectrum of conditions; (3) accumulate fuel supply system experience for design of commercial facilities and large-scale distribution. The minimum evidence of test program success will be the establishment of the practicability and reliability of blends as a transition strategy to straight alcohol fuels or as a progenitor of alcohol/synfuel blends. If the blends are economically competitive at the time of test

completion, it is likely that commercialization will be initiated. If the economics are marginal, local or Federal organizations may continue marketing operations on the basis of local, State, regional, or Federal subsidies and/or incentives.

13878 (CONF-7904105—, pp 486-501) **Alcohol fuels for automobiles.** Pefley, R.R. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

Steady-state power, fuel economy, and exhaust emissions been parametrically studied using a 2300-cc, four-cylinder engine mounted on a dynamometer. Use of pure methanol compression ratios of 10 and 11.3 to 1 has been evaluated. These compression ratios were achieved by milling the stock heads of the engines. Carburetion systems under investigation include stock, sonic, acoustic, and electronic fuel injection. The objective is to determine the best combinations of hardware and control strategy for using pure methanol in these engines.

13879 (CONF-7904105—, pp 502-520) **Vehicle tests with alcohol/gasoline blends and the alternative fuels data bank.** Allsup, J.R. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

In an effort to evaluate the effects of using alcohols and alcohol/gasoline blends in current production automobiles, the Fuel/Engine Systems Research Group (FESR), at the Department of Energy's Bartlesville (Oklahoma) Energy Technology Center (BETC) is conducting research using alcohols and alcohol/gasoline as motor fuels. The overall program consists of: (1) a cooperative research program between BETC and Southwestern Bell Telephone Company (SWB); (2) a cooperative program between BETC and the Environmental Protection Agency (EPA); and (3) a methanol/gasoline blend fleet study. In support of these projects and all other alternate fuels programs, an Alternate Fuels Data Bank Program has been established to provide literature surveys, up-to-date information on current research projects, and summaries on selected subjects and reports of unpublished work or studies that are pertinent to this subject area. (TFD)

13880 (CONF-7904105—, pp 521-533) **Characterization of alcohol/gasoline blends as a stratified-charge engine fuel.** Adt, R.R. Jr. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

Experiments were performed to determine the effect of alcohol addition to unleaded gasoline (Indolene) on the performance and emissions characteristics of a three-valve, carbureted, stratified charge engine if it were in a stock condition and used to power an automobile. Engine torque and speeds selected simulated 30, 40, and 50 mph cruise. The results of the experiments showed: (1) when the alcohol blends were substituted for gasoline with no engine adjustments, the torque and engine speed decreased; (2) in order to regain the Indolene-fueled operation values of torque and engine speed, it was necessary to lower the manifold vacuum by opening the throttle (Figure 387); (3) the fuel-air equivalence ratio with the blends was found to be lower than that found during Indolene-fueled operation; (4) the brake thermal efficiency during blend-fueled operation was found to be, in general, lower than that during Indolene-fueled operation; (5) CO emissions were found to either decrease (30 mph simulation) or increase (40 and 50 mph simulation) depending on the cruising speed being simulated; (6) nitric oxide (NO/sub x/) emissions were, in general, found to decrease with increasing methanol blend level; and (7) FID hydrocarbon emissions were found, in general, to increase with alcohol addition (Figure 392).

13881 (CONF-7904105—, pp 534-542) **Effects of alcohol-containing fuels on spark ignition engine wear.** Owens, E.C. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The program objectives are to evaluate the effects of alcohol fuels on lubrication, deposit formation, and wear in current automotive engines. Since problem areas do exist when using alcohol fuels, lubricant additives or lubricant formulations are to be identified which would alleviate these problems. (TFD)

13882 (CONF-7904105—, pp 543-558) **Potential of ether fuels from coal.** Talbot, A. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The objective of the program is to assess the use of ether fuel from coal to replace petroleum transportation fuels. The program elements include: economics and performance characteristics. Prototype fuels will be prepared, based on results from pilot plant runs, to permit evaluation of their performance in vehicle operation. The various process steps required to produce ether fuel from coal are illustrated. The yield and composition of the liquid fuel are highly dependent on the higher alcohol synthesis reaction, in particular, the amount and nature of the synthesis reaction co-products.

13883 (CONF-7904105—, pp 559-566) **Modification of ethanol fuels for highway vehicle use.** Nakaguchi, G.M. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The objectives of this project are to: (1) identify all significant problems associated with the use of ethanol, straight or blended with gasoline, and ethanol/methanol combinations in highway vehicles; (2) identify and evaluate any potentially practical solutions by way of fuel modification; and (3) make appropriate recommendations for further study and performance testing. Approximately fourteen potential problem areas were selected for study. To better define the problems and to compare the relationships of ethanol to gasoline and methanol, tests were used similar to those used in the previous methanol study. The problem areas studied included: distribution and handling, vehicle performance, materials compatibility, toxicity and safety, and renaturing of ethanol-containing fuels. A discussion of the results obtained in each problem area is presented. (TFD)

13884 (CONF-7904105—, pp 567-578) **Transportation fuels from coal and oil shale.** Hildebrand, R.E. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The DOE programs of interest are refining of syncrudes and indirect liquefaction. The two potential sources of fossil derived transportation fuels are coal and oil shale. Coal can be converted to a liquid by either direct hydro-liquefaction or gasification and conversion of the resultant syn gas to liquids. The direct coal liquids and crude shale oil are aromatic and contain large amounts of S and N. Substantial refining is needed before they can be used as transportation fuels. The indirect liquefaction work seeks improved methods of producing high quality transportation fuels from H_2 and CO mixtures. DOE work has shown that syncrudes can be refined with existing technology. Results show that: (1) syncrudes can be refined by conventional methods; (2) coal liquids require less severe hydrotreatment than shale oil; (3) products are interchangeable with petroleum derived products; and (5) high octane gasoline is cheaper to produce than diesel or jet fuel.

13885 (CONF-7904105—, pp 579-580) **Alternative fuels for transportation: DOE policy.** Blum, E.H. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

The objective of the synthetic liquids development program is to achieve significant production by 1990. The program approach and criteria that governs the program are briefly described. (TFD)

13886 (CONF-7904105—, pp 585-603) **Directions for alternative automotive fuel programs.** Colucci, J.M. Sep 1979.

From 16. highway vehicle systems contractors coordination meeting; Dearborn, MI, USA (24 Apr 1979).

Two recent happenings, the crisis in Iran and the problem at the Three Mile Island Nuclear Powerplant, again brought forth the message that our nation must quickly start to develop our vast nonpetroleum energy resources. The Department of Energy has been sponsoring some research and other programs to develop and utilize alternative fuels. The paper gives an appraisal of the work that is going on and treats those efforts considered to be worthwhile, those not worthwhile, and other studies, currently not in progress, but which need to be started. As a basis for the critique, use is made of the work done at General Motors to look at future automotive fuels, both from a supply and a utilization basis.

MATERIALS

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 12924

13887 **Rapidly quenched metals III. Volume 1.** Cantor, B. (ed.). London, England; Metals Society (1978). vp. (CONF-780726—(Vol.1)).

From 3. conference on rapid quenching; Brighton, UK (3 Jul 1978).

Individual items from the conference were prepared separately for the data base. (GT)

PREPARATION AND FABRICATION

13888 (AD-A—063855) **Phalanx CIWS penetrator rounds.** Sherman, R.G. (Nevada Engineering and Technology Corp., Long Beach, CA (USA)). 28 Feb 1978. Contract N60921-76-C-0287. 50p. NTIS, PC A03/MF A01.

The central purpose of this program was to develop forging know-how on U-2% Mo specifically related to the Phalanx penetra-

tor. The forging process studied was one concerned with producing near net shape penetrator blanks which would reduce raw material requirements and reduce machining costs. The factors which affect the forging process were studied. The results of this work showed that net shape penetrators of 90% of the volume of the penetrator could be forged, thereby reducing material requirements by 17% and eliminating a major portion of the precision machining required. U-2% Mo was found to be an easily forged material, relatively insensitive to forging temperature in the range of 700-1100F.

13889 (COO—2584-3) **Reduction of mixed spinel oxides. Final report, April 1, 1976-August 31, 1978.** De Jonghe, L.C. (Cornell Univ., Ithaca, NY (USA)). Sep 1979. Contract EY-76-S-02-2584. 9p. Dep. NTIS, PC A02/MF A01.

Dense ferrites of nickel and cobalt, pure and alloyed with various amounts of aluminum in solid solution were reduced in hydrogen between 500 and 1000°C. The reaction is topochemical and a product layer proceeds from the surface inward. The rate of the interface advance is determined by a variety of factors including the gas pressure, the temperature, and ferrite composition. In cobalt ferrites, a reaction rate anomaly was observed between 600 and 800°C, depending on the cobalt ferrite composition. In this temperature range, the reaction rate was found to decrease with increasing temperature. This is common in the reduction of iron-bearing oxides. The phenomena is explained in terms of the rate of the scale/oxide interface advance in comparison with the rate at which the wustite subscale forms. The study of the reaction kinetics at various temperatures and pressures permitted the evaluation of a number of important kinetic constants. The relative importance of the gas oxide interface reaction and the solid state diffusion processes is discussed. Much of the reduction rates can be understood in terms of a relatively simple model containing only 2 explicit materials parameters.

13890 (LBL—10007) **Research on the monolithic process of making A-15 superconducting materials.** Hong, M.; Dietderich, D.; Morris, J.W. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 20p. (CONF-790815—33). Dep. NTIS, PC A02/MF A01.

From Cryogenic engineering conference; Madison, WI, USA (21 Aug 1979).

It is possible to produce high T/sub c/ wires or tapes from the V-Ga system by a monolithic process in which an ingot is cast as a supersaturated solution of V and Ga, homogenized at elevated temperature, quenched to preserve the supersaturation, formed into a wire or tape, and finally heat treated at a relatively low temperature to precipitate the superconducting phase. To achieve exceptionally high critical temperatures, the precipitation reaction must be carried out at temperatures below approximately 750°C. The measured critical temperature then becomes a function of the aging time, and reaches a maximum value as high as 14.8°K in alloys containing 17 to 19 at. % Ga. The reason for the exceptionally high critical temperature when the precipitation is carried out at lower aging temperatures is not established, but may be plausibly interpreted as due to a thermodynamic tendency for small precipitates formed from highly supersaturated solid solutions to be rich in solute content.

13891 (ORNL—5609) **Ultrasonic wave propagation in materials with orthotropic (orthorhombic) symmetry with an example of centrifugally cast pipe.** Fitting, D.W.; Adler, L.; Cook, K.V. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 77p. Dep. NTIS, PC A05/MF A01.

The propagation of elastic waves in orthotropic and hexagonal anisotropic material is examined mathematically showing that the elastic constants for these materials may be ascertained from ultrasonic longitudinal and transverse wave velocity measurements. Knowledge of the elastic constants of the material permits calculation of the velocities of longitudinal and transverse waves propagating in any direction. Experimental velocity measurements on samples of centrifugally cast austenitic stainless steel pipe are presented. They compare favorably with theoretical predictions, assuming an orthotropic model.

13892 (SAND—79-1740) **Estimating effective isothermal aging temperature.** Harrah, L.A.; Mead, K.E. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 10p. Dep. NTIS, PC A02/MF A01.

Equivalent temperatures for isothermal aging to simulate fluctuating ambient temperatures are calculated where T(t) is temperature-time function for sinusoidally varying annual and diurnal cycles and ΔE is an activation energy and the average is evaluated from mid-winter to mid-summer. The difference between the effective temperature, T/sub i/, and the mean temperature, for conditions approximating those of arid temperate climates, was found to be as high as 16° celsius. For diffusion controlled reactions the temperature difference can be 7 to 10° celsius.

13893 (UCRL—15158) **Final report on work done under LLL P.O. No. 3964609.** Spencer, C. (Airco, Inc., Murray Hill, NJ (USA). Central Research Labs.). 21 Sep 1979. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

In comparing the results of extrusions of Nb, it was found that the non-uniformity of the Nb extruded at Teledyne Wah Chang Albany (TWCA) is more severe than the other. This correlates with results of the mechanical properties of Nb. Both specimens were given identical extrusion, cold work, and heat treatments. (FS)

13894 (UCRL—52891) **Thermo-mechanical modeling of the gas-tungsten-arc (GTA) welding process.** Duncan, D.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Jan 1980. Contract W-7405-ENG-48. 91p. Dep. NTIS, PC A05/MF A01.

A fundamental study of gas-tungsten-arc (GTA) welding was undertaken. This was initiated with a review of the GTA welding process which lead to the decision to focus experimental and analytical efforts on stationary welds on a pure material. Pure nickel was selected for the test material. Temperature, strain, and distortion measurements were made during the formation of spot welds on circular plates. Transient thermal data were obtained with thermocouples, a radiation pyrometer, and from motion pictures. Local strain was observed qualitatively from Moire interference fringe patterns. Distortion during welding was measured with displacement gages and residual distortion with a profilometer. Experimental measurements are compared with predictions of thermal and mechanical finite element codes.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 13913, 14007

13895 (DOE/ER/01198—1296) **Thermal vacancies and phase separation in bcc mixtures of helium-3 and helium-4.** Fraass, B.A. (Illinois Univ., Urbana (USA). Digital Computer Lab.). 1980. Contract EY-76-C-02-1198. 286p. Dep. NTIS, PC A13/MF A01.

Thesis.

Thermal vacancy concentrations in crystals of ^{3}He-^{4}He mixtures have been determined. A new x-ray diffractometer-position sensitive detector system is used to make measurements of the absolute lattice parameter of the helium crystals with an accuracy of 300 ppM, and measurements of changes in lattice parameters to better than 60 ppM. The phase separation of the concentrated ^{3}He-^{4}He mixtures has been studied in detail with the x-ray measurements. Vacancy concentrations in crystals with 99%, 51%, 28%, 12%, and 0% ^{3}He have been determined. Phase separation has been studied in mixed crystals with concentrations of 51%, 28%, and 12% ^{3}He and melting pressures between 3.0 and 6.1 MPa. The phase separation temperatures determined in this work are in general agreement with previous work. The pressure dependence of T/sub c/, the phase separation temperature for a 50% mixture, is found to be linear: dT/sub c//dP = -34 mdeg/MPa. The x-ray measurements are used to make several comments on the low temperature phase diagram of the helium mixtures.

13896 **Properties of metallic glasses containing actinide metals: 1. Thermal properties of U-M glasses (M = V, Cr, Mn, Fe, Co, and Ni).** Giessen, B.C. (Northeastern Univ., Boston, MA (USA)); Elliott, R.O. (Los Alamos Scientific Lab., NM (USA)). pp 406-411 of Rapidly quenched metals III. Vol. 1. Cantor, B. (ed.). London, England; Metals Society (1978).

From 3. conference on rapid quenching; Brighton, UK (3 Jul 1978).

The results of a preparative and calorimetric study forming part of a continuing investigation of the new actinide glasses are reported. Specifically, lower bounds for the composition limits of glass formation (G.F.) at moderate cooling rates have been obtained for the U-M (M = Mn, Fe, Co, Ni) systems and the thermal stabilities of glasses in these four systems as well as for a U-V glass and a U-Cr glass have been surveyed.

13897 (PNL-SA—6698) **Krypton entrapment in pulse biased sputter-deposited metals.** Bayne, M.A.; Moss, R.W.; McClanahan, E.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1978. Contract EY-76-C-06-1830. 27p. (CONF-780430—7). Dep. NTIS, PC A03/MF A01.

From Conference on metallurgical coatings; San Francisco, CA, USA (3 Apr 1978).

A supported gas discharge sputtering system was constructed to investigate krypton entrapment in high-rate sputter-deposited thick films. Krypton entrapment was studied as a function of substrate and target voltage for nickel, aluminum, titanium and iron deposits. Control of substrate and target voltages was achieved with pulse circuits capable of adjusting the pulse duration and repetition rate. A water-cooled cylindrical copper substrate 15 cm in diameter was used to collect the sputtered metal from a 9-cm diameter cylindrical target. To observe the immediate effect of changes in sputtering parameters on gas trapping, as well as measure the total gas trapped, a sensitive mass flow indicator was installed in the krypton supply of the dynamically pumped system. Data relating

krypton content to substrate bias conditions and deposition rate are discussed in light of the theory of Carter, Colligon and Leck on ion absorption in the presence of sputtering. Krypton contents > 2 at.% were found in the metals studied, all of which were deposited at rates exceeding 1 nm/sec. Computed krypton concentrations agreed with concentrations in samples that were analyzed chemically.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 13893, 13914, 14577

13898 (GA-A—15564) **Influence of a simulated HTGR environment on the mechanical properties of a commercial Ni-Cr-Mo-Fe alloy (Hastelloy Alloy X).** Li, C.C.; Johnson, W.R.; Thompson, L.D. (General Atomic Co., San Diego, CA (USA)). Dec 1979. Contract AT03-76ET35300. 61p. Dep. NTIS, PC A04/MF A01.

The influence of a simulated advanced-reactor helium environment, containing 500 μatm H_2/50 μatm CH_4/50 μatm CO/~ 1 μatm H_2O, on the mechanical properties of two heats of Hastelloy Alloy X is discussed. Simultaneous exposures in air and controlled-impurity helium at temperatures in the range of 650° to 1000°C for times of 3000 h or more were performed. A combination of tensile testing, Charpy V-notch impact toughness testing, and creep testing was used to study the effects of reactor helium/metal interactions on the mechanical behavior of this alloy. Carburization was identified as the primary corrosion phenomenon. Increasing exposure time and temperature were observed to increase the depth of carburization. The increase in carbon concentration in the carburized zone suppressed the additional formation of M_6C, which is observed in air-aged specimens, and resulted in the precipitation of $M_{23}C_6$, a chromium-rich carbide variant. The precipitation of $M_{23}C_6$ in the carburized zone occurred primarily along grain and twin boundaries; however, matrix precipitation was also observed, the degree of which depended on exposure temperature. Strength and impact toughness properties were found to be controlled primarily by thermal aging reactions, with only a small effect related to the carburization. Although tensile and creep ductilities were decreased as a result of carburization, substantial ductility remained. Variation was observed between the two heats, the finer-grained heat appearing to be weaker in the high-temperature creep tests and also possibly more susceptible to a loss of creep strength as a result of carburization.

13899 (NUREG/CR—1070) **Evaluation of the unloading compliance procedure for J integral testing in the hot cell. Final report.** Clarke, G.A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Jan 1980. Contract W-7405-ENG-26. 70p. (ORNL/SUB—7394/1). Dep. NTIS, PC A04/MF A01.

A testing program was initiated to develop a procedure for toughness testing of irradiated materials using J integral methods. An evaluation of presently used procedures and improved techniques was completed to increase the reliability of the unloading compliance method for single specimen J/sub Ic/ determination. Three different heats of pressure vessel steels were used to evaluate the reliability and accuracy of the unloading compliance procedure. A new technique for improved sensitivity of displacement measurements was found to be successful on large 4T specimens. This technique consisted of using a small electrical linear actuator to continuously rezero a 0.635 mm (.025 inch) LVDT. The effects of specimen geometry on both J/sub Ic/ and dJ/da were evaluated using various specimen sizes and varying amounts of side grooving.

13900 (UCRL—50058-79-3) **Advances in materials science, Metals and Ceramics Division. Quarterly progress report, July-September 1979.** Truhan, J.J.; Weld, F.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Oct 1979. Contract W-7405-ENG-48. 64p. Dep. NTIS, PC A04/MF A01.

Research is reported on materials for magnetic fusion energy, laser fusion energy, Al-air batteries, geothermal energy, oil shale, nuclear waste management, thermochemical cycles for hydrogen production, chemistry, and basic energy science. (FS)

13901 (UCRL—52866) **Use of notched beams to establish fracture criteria for beryllium.** Mayville, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Jan 1980. Contract W-7405-ENG-48. 151p. Dep. NTIS, PC A08/MF A01.

Thesis.

The fracture of an improved form of pure beryllium was studied under triaxial tensile stresses. This state of stress was produced by testing notched beams, which were thick enough to be in a state of plane strain at the center. A plane strain, elastic-incremental plasticity finite element program was then used to determine the stress and strain distributions at fracture. A four-point bend fixture was used to load the specimens. It was carefully designed and manufactured to eliminate virtually all of the shear stresses at the reduced section of the notched beams. The unixial properties were obtained.

13902 **Crack-velocity correction factor for the crack-front shape in double torsion specimens.** Pollet, J.C.; Burns, S.J. (Univ. of Rochester, NY). Contract EY-76-S-02-2422. *J. Am. Ceram. Soc.;* **62**: No. 7-8, 426-427(Jul 1979).

The v-G material property curve (where v is the crack velocity and G the crack-extension force) was established from the experimental apparent crack velocity, the average crack-extension force, and the observed crack profile. (FS)

PHYSICAL PROPERTIES

13903 **dHvA studies of A-15 superconductors at H<=40 T.** Arko, A.J. (Argonne National Lab., IL (USA)); Lowndes, D.H. (Oregon Univ., Eugene (USA). Dept. of Physics). *J. Magn. Magn. Mater.;* **11**: No. 1-3, 225-232(Apr 1979).

From Proceedings of the international conference on solids and plasmas in high magnetic fields; Cambridge, MA, USA (18 Sep 1978).

Better single crystals, together with the use of high magnetic fields, have recently resulted in direct dHvA measurements of parts of the Fermi surfaces of the high Tsub(c) superconductors Nb_3Sn and V_3Si. The results of high precision band structure calculations are now beginning to appear for these materials, so that direct comparisons of theory and experiment, for the electronic structure of at least some of the A-15 s, are now possible. The experimental data are reviewed in the light of the available band structure results. Finally, the combined application of high precision quantum oscillation measurements and band structure calculations, to understand the structural transformation and defect behavior of A-15 materials, is briefly considered.

13904 (GA-A—15581) **Determination of tritium permeation rate through T-22 in GCFR helium environment.** Yang, L.; Baugh, W.A. (General Atomic Co., San Diego, CA (USA)). 1980. Contract AT03-76SF71023. 26p. Dep. NTIS, PC A03/MF A01.

Measurements were made on tritium permeation rates through T-22 tubular samples in the temperature range of 300° to 550°C. The tritium source consists of tritium in helium containing hydrogen at 6 vol % and sufficient water vapor to maintain a hydrogen-to-water-pressure ratio of 10, the total pressure being 1.01 x 10^5 Pa (1 atm). Two tritium sources at specific activities of 2.6 x 10^{-3} and 3.1 x 10^{-2} μCi/std cc, respectively, were used for determining how the permeation rate varies with tritium concentration. The T-22 tubular samples have a wall thickness of 0.437 x 10^{-2} m (0.172 in.), and two samples are used for checking the reproducibility of the results. During the measurements, the tritium diffusing through the wall of the sample is swept out with a helium-steam mixture by bubbling helium at atmospheric pressure through a water reservoir maintained at 90°C.

13905 (GEPP-OP—474) **New mathematical technique for determining the parameters of gas permeation through solids.** Kohls, J.F. (Hazleton-Nuclear Science Corp., Palo Alto, CA (USA). Radiochemistry Dept.). 1980. Contract EY-76-C-04-0656. 30p. (CONF-800214—1). Dep. NTIS, PC A03/MF A01.

From 9. annual symposium of the Florida Chapter of the American Vacuum Society; Tampa, FL, USA (11 Feb 1980).

The solution of Fick's equation for gas permeation through solid flat membranes yields a throughput rate equation with two unknown parameters, diffusivity and solubility. The common methods used to evaluate these parameters rely on knowing the equilibrium throughput rate. This equilibrium rate is in some cases rapidly established (on the order of seconds), in other cases slowly established (order of months). Thus, permeation measurements may require equipment usage over a long time period, precluding its use for other experiments. A mathematical technique for predicting the permeation parameters using the unequilibrated portion of the permeation throughput curve has been developed which overcomes this difficulty. The method developed (termed stabilized search) was tested with data simulated using a known amount of error. The predicted parameters were as accurate as the data, but the values were generated in only 20 to 40% of the time required for other methods.

13906 (LBL—8011) **Thermodynamics of solid and liquid group III-V alloys.** Anderson, T.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1978. Contract W-7405-ENG-48. 302p. Dep. NTIS, PC A14/MF A01.

Thesis.

Solid-state electrochemical techniques are applied to the Ga-In-Sb-O system to measure some thermodynamic properties important for the analysis of solid-liquid phase equilibria in these important semiconductor materials. The standard Gibbs energies of formation of the most stable oxides of gallium and of indium are determined with a high-temperature solid-state electrochemical cell utilizing calcia-stabilized zirconia as the solid electrolyte and a ($CO + CO_2$) gaseous mixture as the reference electrode.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 12930, 12935, 13036, 13553, 13566, 13567, 13898, 13900

13907 (COO—4246-11) **Microstructural effects in abrasive wear. Quarterly progress report, September 15-December 15, 1979.** Fiore, N.F.; Kosel, T.H.; Channigiri, M.; Desai, V.; Fulcher, J. (Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science). 15 Jan 1980. Contract EF-77-S-02-4246. 35p. Dep. NTIS, PC A03/MF A01.

This is the 11th quarterly report describing research aimed at establishing quantitative relations between microstructure and wear resistance of highly alloyed materials, including high-Cr white irons and experimental Co-base and Ni-base powder metallurgy (PM) alloys. The specific types of wear under study are low-stress abrasion and gouging wear encountered in mining, coal conversion and transfer applications. The white irons range in carbide volume fracton (v/sub f/) from 10 to 45%. They are of carefully balanced composition to produce maximum carbide hardness, v/sub f/ and matrix hardenability at minimum alloy content. Effort has been devoted to metallographic characterization of these alloys and to low-stress abrasion testing against dry SiO_2. Low-stress abrasion resistance passes through a maximum at intermediate v/sub f/, a finding which corroborates wet-sand, low-stress test results from another laboratory. Low- and high-matrix alloy content Co-base alloys are also under investigation. Both types of alloys have been processed by powder metallurgy (PM) to display a uniform array of fine, medium or coarse carbides in a FCC matrix. Extensive effort has been expended to develop metallographic procedures for characterizing the microstructures of the alloys. Of particular significance is the development of a one-step electrolytic etching-staining procedure which reveals matrix, matrix grain boundaries and carbides simultaneously in high contrast.

13908 **Surface morphology of low energy hydrogen ion eroded stainless steel.** Mattox, D.M.; Sharp, D.J. (Sandia Labs., Albuquerque, NM (USA)). *Radiat. Eff.;* **41**: No. 3, 185-186(1979).

It is shown that the deformation of 304 stainless steel affects the surface microtopography generated by low energy (1000 eV) hydrogen ion erosion. The erosion yields of annealed and cold rolled surfaces are essentially the same with a value of 0.030 to 0.034 atoms/ion.

RADIATION EFFECTS

13909 (ANL—79-40, pp 219-225) **Effect of dose on the evolution of cavities in 500-keV $^4He^+$-ion irradiated nickel.** Fenske, G.; Das, S.K.; Kaminsky, M.; Miley, G.H. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The aim of the present study is to determine how the size, density, and volume fraction of cavities (swelling) change as a function of dose during the initial stages of bubble formation. Typical bright-field micrographs of the cavity and dislocation microstructures of nickel foils implanted with 500-keV $^4He^+$ ions to a dose of 1 x 10^{21} ions/m^2 are shown. A large fraction of the cavities appears to have been heterogeneously nucleated at or near dislocations. The dislocation microstructure near the peak in the damage consists of dense dislocation tangles. The increase in the cavity diameter and in the number density with increasing dose can be clearly seen. Quantitative results on the variations in the average cavity diameter and number density, and in the swelling due to cavities as a function of depth for nickel implanted at 500°C with 500-keV $^4He^+$ ions, for doses ranging from 2 x 10^{19} ions/m^2 to 1 x 10^{21} ions/m^2 are presented, along with the depth distributions of the energy deposited into damage and of the projected range. The maximum swelling occurs at depths 8 to 15% deeper than the peak in the projected range profile. 3 figures, 1 table. (RWR)

13910 (ANL—79-40, pp 225-227) **Temperature dependence of the relationship between blister diameter and blister skin thickness for helium-ion-irradiated Nb.** Das, S.K.; Kaminsky, M. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The blisyter diameter, D/sub mp/ and blister skin thickness, t, values were evaluated for only annealed polycrystalline niobium for irradiation with $^4He^+$ ions in the energy range 20 keV to 500 keV at 300°C and at 700°C. For the temperature range studied, the blister skin thickness values did not change within the experimental error limits for a given projectile energy. A log-log plot of D/sub mp/ against mean blister skin thickness values is shown for irradiation at room temperature, at 300°C, and 700°C. For irradiation at 300°C a power curve fit through the data points gives the relationship D/sup mp/ = 9.6 $t^{1.19}$. The results reported here show that, as the irradiation temperature is increased, the values for both the exponent and the pre-exponential factor in the D-t relationship decrease. 1 figure. (RWR)

13911 (ANL—79-40, pp 227-230) **Surface damage of TFTR protective plate candidate materials by energetic D^+ irradiation.** Kaminsky, M.; Das, S.K. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

Experiments were conducted to determine the surface damage of ATJ graphite, V, Cu, and Type 316 stainless steel under 60-keV D^+ irradiation. The irradiations were conducted in the pulsed mode. For a total accumulated dose of 8.1 x 10^{18} ions/cm^2, blisters were readily seen for Cu surfaces, but no blisters were observed on Type 316 stainless steel and vanadium surfaces. For the case of ATJ graphite, the surface damage was observed in the form of ridges and grooves. In the case of copper, many large blisters with diameters ranging from 3.5 μm to 46 μm are observed in addition to some small ones (average diameter ~ 2 μm. The blister density of the large blisters is the highest in the case of copper (1.1 x 10^5 blisters/cm^2). These observations of blister formation are related to the differences in the premeability of deuterium in these materials. An examination of the cross section of the ridges in fractured samples of graphite indicates that they are not hollow. The mechanisms of formation of these ridges is not clear at present. 1 figure. (RWR)

13912 (ANL—79-40, pp 230-235) **Damage of niobium surfaces caused by bombardment with $^4He^+$ ions of different energies typical for T-20.** Guseva, M.I.; Gusev, V.; Martynenko, Yu.V.; Das, S.K.; Kaminsky, M. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The aim of the present studies was to study surface damage due to blistering of both annealed and cold-worked niobium (a candidate first wall material for keV) irradiated sequentially with $^4He^+$ ions with energies of 0.5 to 1800 keV for a total dose of 5.0 C/cm^2. A typical surface of cold-worked Nb after irradiations with $^4He^+$ ions with increasing energy from 0.5 to 90 keV is shown. The blister diameters range from 0.1 μm to 3 μm, and most of the blisters have exfoliated. The blisters fall into several size classes, the two most dominant ones having most probable blister diameters of ~ 0.27 μm and ~ 2.0 μm. The skin thickness of the larger blisters was measured to be ~ 0.23 μm. Also shown is the same area after irradiation with 150-1800-keV $^4He^+$ irradiation for a dose of 0.66 C/cm^2. A few additional blisters can be seen. A cold-worked Nb surface that was irradiated only with 150-1800-keV $^4He^+$ ions is also shown. It is seen that prior irradiation with 0.5-90-keV $^4He^+$ helped in significantly reducing blistering. For a total dose of 0.5 C/cm^2, the erosion yield due to helium blistering of Nb ranges from (5.4 +- 2.0) x 10^{-3} to (1.5 +- 0.7) x 10^{-2} atoms/ion. For the cold-worked Nb target the results indicate clearly that the $^4He^+$ implantations for the energy range from 0.5 to 90 keV help to reduce both the density and diameter of blisters formed by subsequent He-implantation for the energy ranging from 150 to 1800 keV. 2 figures. (RWR)

13913 (COO—1367-109) **Effect of point defects on mechanical properties of metals. Technical progress report, December 1, 1979-January 31, 1980.** Meshii, M. (Northwestern Univ., Evanston, IL (USA)). Jan 1980. Contract EY-76-S-02-1367. 7p. Dep. NTIS, PC A02/MF A01.

This progress report consists of five sections. The importance of morphological study in conjunction with mechanical tests is emphasized and is explained in niobium, the surface effect on crystal plasticity of niobium, surface film softening in Ni-plated iron, and the hydrogen charging effect in iron.

13914 (DOE/TIC—11086) **Design equations for stress-free swelling of 20% cold worked D9.** Bates, J.F. (Hanford Engineering Development Lab., Richland, WA (USA)). Nov 1979. Contract EY-76-C-14-2170. 11p. Dep. NTIS, PC A02/MF A01.

The current design equation for developing Alloy D9 is given. At several temperatures it is possible to determine swelling rate parameters. Equations are also given for total in-reactor creep, stress rupture, and yield strength. (FS)

13915 (UCID—18523) **Radiation effects on superconductors and magnet stabilizer materials.** Van Konynenburg, R.A.; Guinan, M.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 8p. Dep. NTIS, PC A02/MF A01.

Previously-irradiated Nb_3Sn wires have been given additional irradiation at room temperature in order to reach the anticipated serious decline in critical current and to evaluate the fluence where it occurs. In addition, an experiment is in preparation which will measure the magnetoresistance of copper and aluminum in fields up to 12 tesla after 14-MeV neutron irradiation. The same experiment will test the effects of repeated irradiation and room temperature annealing on NbTi critical current.

CERAMICS, CERMETS, AND REFRACTORIES

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 12921

STRUCTURE AND PHASE STUDIES

13916 (LA—8083) **Microstructural damage produced by helium in aged $^{238}PuO_2$ fuels.** Land, C.C. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 15p. Dep. NTIS, PC A02/MF A01.

Microstructural damage is produced in aged $^{238}PuO_2$ fuels used to power radioisotopic heat sources by the generation and release of the helium arising from alpha decay of the fuel. We obtained information about the nature and extent of this damage from metallographic examination of fuel pellets ranging in density from 87 to 94% with a grain size range of 6 to 30 μm that either were stored at ambient temperature for 18 months and then heated at 900, 1150, or 1360°C or were stored at 900, 1150, or 1350°C for 27 months. Microstructural damage was not observed in the fuel pellets stored at ambient temperature and then heated at 900°C, but grain boundary bubble damage was observed in the pellets stored at ambient temperature and then heated at either 1150 or 1350°C. More extensive damage occurred in those pellets heated at 1350°C. Four of the higher density pellets (92 and 94% dense) stored at 900°C shattered during storage and the rest appeared to be highly strained. The pellets stored at 1150°C were damaged only slightly but were somewhat strained and appeared to have released their helium inventory only partially. All pellets stored at 1350°C showed swelling and extensive void agglomeration. These data suggest that the best fuel operating temperature, as far as helium damage is concerned, would be ~ 1200°C because below this temperature the fuel becomes highly strained and above this temperature the fuel swells ad becomes somewhat friable. Both these situations could adversely affect the impact behavior of the fuel from the standpoint of strength and fines generation.

13917 Raman and infrared spectroscopic studies of the crystalline phases in the system Pb_2SiO_4-$PbSiO_3$. Furukawa, T.; Brawer, S.A.; White, W.B. (Pennsylvania State Univ., University Park). Contract EY-76-S-02-2754. *J. Am. Ceram. Soc.;* **62**: No. 7-8, 351-356(Jul 1979).

The stable and metastable phase relations in the system Pb_2SiO_4-$PbSiO_3$ were reexamined using Raman and ir spectroscopy to characterize the phases. Three stable phases, H-Pb_2SiO_4, M-Pb_2SiO_4, and $PbSiO_3$ (alamosite) and four metastable phases, L-Pb_2SiO_4, phase X, L-$PbSiO_3$, and hexagonal $PbSiO_3$, occur in the portion of the system investigated. The Raman and ir spectra allow some conclusions to be drawn about the structures of silicate groups in the lead silicate crystalline phases.

13918 Analysis of electrolyte polarization in polycrystalline sodium β''-alumina by a complex admittance method. Jakubowski, W.; Whitmore, D.H. (Northwestern Univ., Evanston, IL). Contract EY-76-S-02-2564. *J. Am. Ceram. Soc.;* **62**: No. 7-8, 381-385(Jul 1979).

The polarization behavior of lithia-stabilized sodium β''-alumina in the form of polycrystalline pressed and sintered specimens was studied at 100 to 400°C by observing the isothermal values of the complex admittance from ≈ 5 Hz to 500 kHz. Analyzing these data in the complex admittance plane in terms of an equivalent circuit for the system made it possible, when ion-blocking electrodes were used, to distinguish the separate contributions of the grain boundaries and the bulk crystals to the total electrolyte resistance. These results gave activation energies of 0.32 to 0.41 eV for the grain-boundary resistance and 0.11 to 0.14 eV for the bulk resistance. The prefactors in the Arrhenius expressions for these resistances appeared to be more sensitive to factors such as specimen composition, microstructure, and specimen preparation conditions than are the activation energies.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 13563, 13725, 13919

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 13725, 13918, 14032

13919 (SAND—78-1694) **Development of high thermal expansion glasses for sealing to aluminum alloys, I.** Wilder, J.A. Jr. (Sandia Labs., Albuquerque, NM (USA)). Nov 1978. Contract EY-76-C-04-0789. 33p. Dep. NTIS, PC A03/MF A01.

The feasibility of using phosphate glasses as insulator materials which can be hermetically sealed to aluminum alloys was examined. Control of selected properties was achieved by compositional variation. A series of glasses was produced with thermal expansion coefficients of 160 to 260 x 10^{-7} $°C^{-1}$ (aluminum = 235 x 10^{-7} $°C^{-1}$). Helium permeabilities of 5 x 10^{8} (atoms/s-cm-atm) at 25°C are about equal to the glass-ceramic currently used in neutron tubes. Leach rates in water similar to those of window glass of approximately 1.2 x 10^{-8} (gm/cm^2 - min) were attained. The fracture toughness of these glasses, 0.4 MPa - m/sup 1/2/, is approximately 1/2 that of silicate glasses. Several of these glasses have been hermetically sealed to 6061-TO aluminum alloy.

13920 Phase equilibria in the oxidation of impure silicon nitride. Williams, R.O.; Tennery, V.J. (Oak Ridge Natl Lab, Tenn). *J. Mater. Sci.;* **14**: No. 7, 1567-1571(Jul 1979).

Because of its useful mechanical properties and its chemical resistance silicon nitride, Si;sub 3;N;sub 4;, is of considerable interest as a high-temperature ceramic. Specifically, it is the prime candidate for a ceramic-containing gas turbine. In many applications the oxidation resistance of Si;sub 3;N;sub 4; is of interest. Recently reported results indicate that the oxidation of the hot-pressed material can lead to blisters in the protective oxide and the formation of pits. Such results are of concern, as this might lead to enhanced oxidation as well as mechanical degradation. This study examines the thermodynamics of this material to determine what equilibrium phases should be present and what gas might be responsible for the blisters. 21 refs.

13921 Effect of microstructure and microcracking on the thermal conductivity of UO_2-U_4O_9. Buykx, W.J. (Australian Atomic Energy Commission, Lucas Heights). *J. Am. Ceram. Soc.;* **62**: No. 7-8, 326-332(Jul 1979).

Several microstructures were produced in dense polycrystalline UO_2-U_4O_9 specimens by cooling UO/sub 2 + x/ solid solutions at differentrates. Void formation (intragranular pores, grain-boundary microcracks) was observed in specimens which had a nonuniform distribution of the U_4O_9 precipitate: such formaton was probably caused by the relief of stresses generated by differential thermal contraction. The microstructures were assessed quantitatively and used to calculate thermal conductivities from theoretical models. The effect of microcracking was calculated. Thermal conductivities were also determined from thermal diffusivity values measured by the laser-flash method. The thermal conductivity was primarily infuenced by the amount of U_4O_9 present and the occurrence of voids, whereas the effect of U_4O_9 distribution was minor. Good agreement was obtained between theoretical predictions of thermal conductivity based on microstructure and experimental values.

13922 Densities of SiO_2-Al_2O_3 melts. Aksay, I.A. (Univ. of California, Berkeley); Pask, J.A.; Davis, R.F. Contract W-7405-ENG-48. *J. Am. Ceram. Soc.;* **62**: No. 7-8, 332-336(Jul 1979).

From Pacific Coast regional meeting; Portland, OR, USA (24 Oct 1972).

The densities of binary aluminosilicate melts were measured x-radiographically as a function of Al_2O_3 concentration between 1800 and 2000°C. Within this temperature range, the density curves vary linearly and are parallel from fused SiO_2 to ≈ 30 to 45 mol % Al_2O_3, depending on the temperature. At higher Al_2O_3 contents negative deviation from linearity increases with increasing temperature. Recent supplementary research efforts on various aspects of the system SiO_2-Al_2O_3 indicate that the changing coordination and structural role of the aluminum ion may be a primary factor in determining the shapes of the density curves.

RADIATION EFFECTS

13923 (PNL—3228) **Design of a capsule for irradiating graphite at temperatures up to 2000°C.** Gray, W.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jan 1980. Contract EY-76-C-06-1830. 31p. Dep. NTIS, PC A03/MF A01.

A non-instrumented capsule has been designed for irradiating graphite samples at temperatures up to 2000°C, and a device for measuring the temperature has been designed and laboratory tested. Tungsten heater elements used to help achieve the high temperatures were found to react with the graphite even though there was no direct contact. Despite this reaction, laboratory tests indicate that the tungsten heater elements will be suitable for irradiations up to three or four weeks in duration. A description of the materials and properties to be tested for fusion reactor applications is also given.

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 13287

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 13287

13924 (GRI—78/0014) **Development of improved plastic piping materials and systems for fuel gas distribution. Annual report, 1978.** Cassady, M.J.; Lee, C.S.; Wong, W.M.; Cassady, M.M. (Battelle Columbus Labs., OH (USA)). 1 Aug 1979. 119p. Dep. NTIS, PC A06/MF A01.

Summaries of work done in 1978 are given. Research is dominated by consideration of crack initiation and propagation in polythylene piping compounds including development of methods to study the phenomena and the influence of aging and molecular and morphological factors. Environmental stress crack resistance (ESCR) measurements were emphasized. Data from ESCR continues to correlate with independent measurements of fracture toughness. Cyclic fatigue testing was found to accelerate slow crack behavior. Studies of running crack tendency in polyethylene suggest that residual stress in the pipe wall contributes to the problem. (FS)

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 13995

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 13248, 13249, 13250, 13251, 13254, 13255, 13256, 13257, 13258, 13259, 13260, 13261, 13263, 13265, 13268, 13270, 13272, 13273, 13274, 13278, 13280, 13281, 13282, 13289

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 13919, 13925, 13927, 14524

PROPERTIES

REFER ALSO TO CITATION(S) 13289, 13903, 13919, 14123, 14602

13925 (DOE/ER/01198—1295) **Effect of hydrostatic pressure on the ionic conductivity of some crystals with the fluorite structure.** Oberschmidt, J.M. (Illinois Univ., Urbana (USA). Dept. of Physics). 1980. Contract EY-76-C-02-1198. 180p. Dep. NTIS, PC A09/MF A01.

Thesis.

The effect of hydrostatic pressure on the ionic conductivity of CaF_2, SrF_2, BaF_2, CdF_2, $SrCl_2$, PbF_2, $PbCl_2$, $PbBr_2$ and PbI_2 was studied for pressures up to 0.6 GPa and temperatures up to near the melting point. The activation volumes for extrinsic vacancy motion were obtained from the effect of pressure on the conductivity of doped and oxygen contaminated samples. The formation volumes of intrinsic defects were calculated from measured activation volumes at high temperatures. The defect formation volumes are found to be uniformly small and consistent with the dominance of Frenkel defects in all cases except $PbCl_2$ and $PbBr_2$, where large formation volumes were observed, indicating Schottky defects. High pressure phase transitions in PbF_2, $SrCl_2$ and PbI_2 were observed by the change in sample resistance across the transition. Transition temperature and pressure data are presented for pressures to 0.55 GPa and temperatures to near the melting point in PbI_2, to 850°K for PbF_2 and to 1050°K for $SrCl_2$. The temperature dependence of the ionic conductivity was also studied in the above materials. Good agreement with published results was obtained except in the cases of $PbCl_2$ and $PbBr_2$.

13926 (EGG—1183-1717(Rev.1)) **Corner burn test of composite materials.** Adamitis, A.D.; Bowman, F.M. (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). Nov 1979. Contract EY-76-C-08-1183. 72p. Dep. NTIS, PC A04/MF A01.

The test shows that the combination of the fire retardant materials did withstand the type of fire anticipated in a typical trailer, minimizing damage and losses to the facility. The possibility of a total loss due to fire in a structure built of these materials would be reduced significantly if fuel loading does not exceed 14 pounds. Also, the combination of fire retardant materials did not create dangerous outgassing or the possibility of explosion due to vapor mixture. Additionally, the test establishes a base of information that can be used for comparison, if other labeled materials were chosen for construction. The original mock-up structure was not affected by the testing; therefore, future experiments could be conducted at considerably reduced costs to the experimenters.

13927 Pressure and temperature dependences of the ionic conductivities of cubic and orthorhombic lead fluoride (PbF_2). Samara, G.A. (Sandia Lab, Albuquerque, NM). *J. Phys. Chem. Solids;* **40**: No. 7, 509-522(1979).

A detailed study of the effects of temperature and hydrostatic pressure on the ionic conductivity of PbF_2 in both the cubic (Fm3m-O/sub h/^{5}) and orthorhombic (Pmnb-V 16/2h) phases was performed with some emphasis on the changes in conductivity accompanying the transition between the two phases. Both phases exhibit relatively high conductivities and become supersonic conductors at high temperatures. As a function of temperature, the conductivity in both phases exhibits a number of activated regions (or stages). Measurements on a variety of samples with different impurities, along with earlier published data, have allowed a determination of the conduction mechanism in the various stages. The activation energies for the motion of F- ion vacancies and interstitials as well as the formation energies of Frenkel defects in the two phases were determined. These energies are relatively small, compared, e.g., with other crystals having the fluorite structure (Fm3m-O/sub h/^{5}), and this can be explained in terms of the large dielectric constants and relatively soft phonons in PbF_2.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 13911, 14118

13928 (BNL—27014) **Radiation induced color center and colloid formation in synthetic NaCl and natural rock salt.** Levy, P.W.; Swyler, K.J.; Klaffky, R.W. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 15p. (CONF-7909101—3). Dep. NTIS, PC A02/MF A01.

From 3. europhysical topical conference on lattice defects in ionic crystals; Canterbury, UK (17 Sep 1979).

F-center and colloid particle formation has been studied in synthetic NaCl and natural rock salt crystals with apparatus for making optical absorption measurements during irradiation. F-center and colloid formation are functions of temperature, dose, dose rate, strain applied prior to irradiation and numerous other factors. Many of the observed properties are in accord with the Jain-Lidiard theory for radiation induced F-center and colloid growth above room temperature.

13929 (SAND—79-2372C) **Electron-beam induced absorption and hardening in fiber-optic waveguides to 1060 nm laser pulses.** Landry, M.J.; Davis, H.P. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract EY-76-C-04-0789. 16p. (CONF-800307—1). Dep. NTIS, PC A02/MF A01.

From Fiber optic in the nuclear environment symposium; Adelphi, MD, USA (25 Mar 1980).

For Corning Glass Work (CGW) and Valtec Corporation (VC) fiber-optic waveguides (FOWs), we have determined the coupling efficiencies (output/input energy) before (R_1) and after (R_2) electron-beam irradiation, the output energy density, the induced attenuation or loss (L/sub I/) and its decrease as a function of time, and hardening as a function of number of Febetron shots (N/sub T/). The FOWs were electron-beam irradiated with 8.3 to 12.3 J/cm^2 for a 2.36 to 2.84 x 10^6 R (^{60}Co equivalent) dose. The output laser energy density varied from 0.19 to 2.12 kJ/cm^2 which was about 50% of the input surface threshold damage level previously measured in similar FOWs. The values of R_1, 40.1 to 67.0%, were less than those previously measured. The induced attenuation (L/sub I/) as a function of recovery time (after electron-beam irradiation) was linear on log-log plot for a short time ($< 2.2 \times 10^{-4}$ s), changing from 1.8 to 0.2 dB/cm in slightly larger than a one order of magnitude change in time. The rate of recovery decreased with increasing time so that the total change in L/sub I/ was about 3 orders of magnitude in 6 orders of magnitude change in time. A slight hardening (decrease in R_1/R_2 occurred in CGW fibers with an increasing number of Febetron electron pulses.

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 12977, 12978, 13042, 14600

13930 (LBL—10138) **Crossed beam studies of full and half collisions.** Sparks, R.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 173p. Dep. NTIS, PC A08/MF A01.

Thesis.

Results of two experiments performed on a new very high resolution crossed molecular beams apparatus are discussed. The first experiment, photofragmentation of methyl iodide, is deconvoluted to yield vibrational state distributions for the recoiling methyl fragment. These distributions are then analyzed in terms of half-collision models and Franck-Condon factors. The second experiment, a full-collision example, is the reaction of F atoms with H_2 and D_2. Laboratory angular and velocity distributions for both systems are obtained at several energies. Center-of-mass product distributions

are calculated and discussed in terms of recently predicted state dependent resonance phenomena for the reaction. The design of the new apparatus is also discussed.

13931 (PNL—2850(Pt.4), pp 5.1-5.3) **Environmental pollution analysis instruments and methods development.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Progress is reported in five fields: environmental pollution analysis instruments and methods development (ultra-low-level mercury in water, x-ray fluorescence, organometallic species in oil shale retorting effluents), environmental pollutant characterization by direct-inlet mass spectrometry ($CsNO_3$ calibration), trace analysis by laser excitation (oxygen quenching of PAH fluorescence), holography applications to environmental studies, and certified research materials (elemental abundances in IAEA standard fish homogenate). (DLC)

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 13111, 13956, 13957

13932 (DP—1546) **High-capacity neutron activation analysis facility.** Hochel, R.C.; Bowman, W.W.; Zeh, C.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jan 1980. Contract EY-76-C-09-0001. 30p. Dep. NTIS, PC A03/MF A01.

A high-capacity neutron activation analysis facility, the Reactor Activation Facility, was designed and built and has been in operation for about a year at one of the Savannah River Plant's production reactors. The facility determines uranium and about 19 other elements in hydrogeochemical samples collected in the National Uranium Resource Evaluation program, which is sponsored and funded by the United States Department of Energy, Grand Junction Office. The facility has a demonstrated average analysis rate of over 10,000 samples per month, and a peak rate of over 16,000 samples per month. Uranium is determined by cyclic activation and delayed neutron counting of the U-235 fission products; other elements are determined from gamma-ray spectra recorded in subsequent irradiation, decay, and counting steps. The method relies on the absolute activation technique and is highly automated for round-the-clock unattended operation.

13933 (LA—8192-MS) **Nuclear techniques for the chemical analysis of environmental materials.** Gladney, E.S.; Curtis, D.B.; Perrin, D.R.; Owens, J.W.; Goode, W.E. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 95p. Dep. NTIS, PC A05/MF A01.

The specific nuclear methods used by the Environmental Surveillance Group for elemental analysis of water, geological, and biological samples are described in detail. Reactor facilities, thermal and epithermal neutron activation, capture γ-ray spectrometry, and delayed neutron assay are covered. Detailed tabulations of γ-ray emitting species by both isotope and energy are included.

13934 (N—79-22741) **He, Ne and Ar composition in a neutron activated sea-floor basalt glass.** Stettler, A.; Bochsler, P. (Bern Univ. (Switzerland). Physikalisches Inst.). Aug 1978. 44p. NTIS PC A03/MF A01.

The composition of helium, neon and argon in the glassy rim of a fresh oceanic basalt form the East Pacific Rise was measured. Three splits of the sample were subjected to neutron irradiation prior to analysis to investigate the noble gas release as a function of different neutron dose. Including the He and Ne results from the irradiated specimens, it was possible to determine the concentrations of Li and Mg and to estimate upper limits for Na and F in addition to the concentrations of K, Ca and Cl which are measured routinely as a byproduct of the Ar-39-Ar-40 dating method.

13935 (PNL—2850(Pt.4), pp 2.45-2.51) **Radiation instrumentation: radiological chemistry.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Program efforts were concentrated in the following areas: development of low-level radiochemical laboratory techniques, in-situ monitoring techniques, and activation analysis technology.

13936 **Computers in activation analysis and gamma-ray spectroscopy.** Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979). 905p. (CONF-780421—). NTIS $15.00.

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Seventy-three papers are included under the following session headings: analytical and mathematical methods for data analysis; software systems for γ-ray and x-ray spectrometry; γ-ray spectra treatment, peak evaluation; least squares; IAEA intercomparison of methods for processing spectra; computer and calculator utilization in spectrometer systems; and applications in safeguards, fuel scanning, and environmental monitoring. Separate abstracts were prepared for 72 of those papers. (DLC)

13937 **NURAB, a system for processing neutron-activated samples.** McMillan, G.G.; Carver, R.D. (Lawrence Livermore Lab., CA). pp 253-263 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

The National Uranium Resource Evaluation (NURE) is a Department of Energy directed program to develop and compile geologic data and other information with which to assess the magnitude and distribution of uranium resources and to determine areas favorable for the occurrence of uranium in the United States. NURAB is a computer system to control inventory and process neutron-activated samples as a part of the NURE program. The NURAB system controls the flow of the data through the analytical processing codes. It provides for automatic archival storage and retrieval of all information via dynamic structured directory files and allows on-line interactive modification and interrogation of information by the user. The system provides for the identification and processing of calibrations, standards, quality assurance, and field samples. It also defines the control and calculational parameters for GAMANAL and NURDAC, codes for interpreting gamma-ray spectra. The results from the NURAB system as well as from other data sources are sent to the data-base system of the NURE program for inclusion in the data files with other information from the survey.

13938 **Interactive computerized system for the analysis of gamma-ray spectra for heavy-ion nuclear reactions.** Morrissey, D.J.; Otto, R.J.; Lee, D.; Liljenzin, J.O.; Binder, I.; Fowler, M.M.; Loveland, W.; Seaborg, G.T. (Univ. of California, Berkeley). pp 264-270 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A system for the yield analysis of radionuclides produced in heavy-ion nuclear reactions is presented. The system is based on gamma-ray spectroscopic measurements of the induced activities, automatic peak identification and fitting with the SAMPO code, and an interactive decay-curve identification process.N A computer code has been developed which facilitates this process by binding together an updated gamma-ray catalog, the measured decay curves, and the ability to fit varying components to the data.

13939 **Data reduction for a high-throughput neutron activation analysis system.** Bowman, W.W. (Savannah River Lab., Aiken, SC). pp 271-177 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

To analyze samples collected as part of a geochemical survey for the National Uranium Resource Evaluation program, Savannah River Laboratory has installed a high-throughput neutron activation analysis system. As part of that system, computer programs have been developed to reduce raw data to elemental concentrations in two steps. Program RAGS reduces gamma-ray spectra to lists of photopeak energies, peak areas, and statistical errors. Program RICHES determines the elemental concentrations from photopeak and delayed-neutron data, detector efficiencies, analysis parameters (neutron flux and activation, decay, and counting times), and spectrometric and cross-section data from libraries. Both programs have been streamlined for on-line operation with a minicomputer, each requiring $\sim$ 64 kbytes of core. 3 tables.

13940 **Control software for a high-throughput neutron activation analysis system.** Bowman, W.W.; Maddox, J.H.; Wren, H.F. (Savannah River Lab., Aiken, SC). pp 367-372 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

To provide uranium, thorium, and associated elemental analyses of about 300,000 samples collected for the National Uranium Resource Evaluation program, Savannah River Laboratory has installed a high-throughput neutron activation analysis facility. The facility is totally automated and is controlled by a minicomputer, with respect to sample handling, data acquisition, and data reduction. The software package described in this paper resulted from an extensive software-design phase that was undertaken to incorporate systematically as much analytical flexibility as possible into a minimum amount of coding. The control portion of the software consists of 32 separate modules containing about 150 subroutines.

13941 NAALSQ: a program for neutron activation analysis with least-squares deconvolution of the gamma spectra on a minicomputer. Kelley, M.T. (Tennecomp Systems, Inc., Oak Ridge, TN); Riley, J.E. Jr.; Gleason, G. pp 456-464 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A computer program has been developed for use on Tennecomp TP-5000 or TP-5/11 computer-based spectrum analysis systems which performs the calculations of neutron fluxes and isotopic concentrations involved in absolute neutron activation analyses. The program fit Gaussian components to all photopeaks located. Automatic deconvolution of multiplets is done when indicated by high residuals from the least-squares fit. Photopeak identification is accomplished through comparison with gamma-ray energies stored in complete isotope libraries. Experimental data are presented which demonstrate the capability to perform simultaneous multielemental instrumental analyses with accuracies of better than +-10%. 3 tables.

13942 Consistent set of nuclear-parameter values for absolute INAA. Heft, R.E. (Univ. of California, Livermore). pp 495-510 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Gamma spectral analysis of irradiated material can be used to determine absolute disintegration rates for specific radionuclides. These data, together with measured values for the thermal and epithermal neutron fluxes and irradiation, cooling, and counting-time values, are all the experimental information required to do absolute instrumental neutron activation analysis. The calculations required to go from product photon emission rate to target nuclide amount depend on values used for the thermal-neutron-capture cross section, the resonance absorption integral, the half-life, and photon branching ratios. Values for these parameters were determined by irradiating and analyzing a series of elemental standards. Results of these measurements were combined with values reported by other workers to arrive at a set of recommended values for the constants. Values for 114 nuclides are listed.

13943 Novel techniques for data storage and rapid retrieval at Lawrence Livermore Laboratory. Mode, V.A.; McMillan, G.G.; Carver, R.D. (Univ. of California, Livermore). pp 511-520 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

The design and implementation of very large data bases, such as those associated with activation analysis and gamma-ray spectroscopy, require the use of sophisticated techniques if they are to run efficiently on modern computers. Linked controllees and index tabling are two novel techniques that have been developed. They are simple to understand and use and are very effective on both large and small digital computers. Linked controllee operation is the direct execution and control of one functional code by another code without user interaction. Index tabling is the specialized design of data files and addressing tables to achieve rapid retrieval of desired relationships while minimizing data-base management time and expense. These techniques are not being used in very large data bases of gamma-ray spectroscopic results for the Lawrence Livermore Laboratory's nuclear test program and the National Uranium Resource Evaluation program.

13944 Computer-controlled cyclic activation analysis with a ^{252}Cf-^{235}U subcritical multiplier. Wogman, N.A.; Brown, D.P.; Rieck, H.G. Jr.; Laul, J.C. (Battelle-Northwest, Richland, WA). pp 728-738 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A computer-controlled cyclic ^{252}Cf activation-analysis facility has been developed for routine multielement analysis of a wide variety of solid and liquid samples. The irradiation facility contains 105 mg of ^{252}Cf placed in a 93% ^{235}U-enriched uranium core which is subcritical with a k effective of 0.985. The number of irradiation and counting cycles, storage of gamma-ray spectra, decay periods, and counting periods are monitored by a TN-11 computer-based multichannel analyzer. Data reduction of gamma-ray spectra is accomplished with a PDP-11/35 or PDP-15 computer system. Detection limits for about 65 elements have been determined to be at or below the part-per-million concentration level.

13945 Rapid analysis of short-lived neutron-irradiation products using a minicomputer-based pulse-height analyzer. Anderson, D.L.; Failey, M.P.; Zoller, W.H. (Univ. of Maryland, College Park). pp 739-745 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

In instrumental neutron activation analysis, concentrations of many elements (Al, V, S, Cu, Ti, Ca, Mg, Br, I, Cl, In, Ba, Mn, Sr, K, Zn, Ga, and Na) in particulate matter, fuels, and ashes are usually determined from gamma-ray spectra obtained within an hour after the samples have been irradiated for a short time. A standard method for data reduction has been to store the spectra on magnetic tape and later analyze them with a fitting routine and perform decay corrections and comparison with standards on a large, central, time-sharing computer. With the recent availability of minicomputer-based pulse-height analyzers with considerable software capability, complete reduction of the accumulated spectra can be accomplished on line without the use of a larger computer. A same-day analysis technique for a large number of samples was developed in which only the peaks of interest and any interferences are analyzed, which results in a fast turnaround for activation-analysis data.

13946 Computer methodology and its applications to geological and environmental matrices. Laul, J.C.; Wilkerson, C.L.; Crow, V.L. (Battelle-Northwest, Richland, WA). pp 840-856 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

The computer program CANGAS developed for quantitative neutron activation analysis-gamma-ray spectrometry is based on the principle of manual selection of a photopeak area and Compton background channels of the identified photopeaks of interest in a spectrum. It does not involve shaping of a photopeak. Our approach to computer analysis has been very satisfactorily tested by synthetic test gamma spectra consisting of 36 photopeaks of different relative intensities in the 60- to 1500-keV energy range. It has been further successfully applied in the analysis of some 33 elements by instrumental neutron activation analysis in geological and environmental matrices (standards: US Geological Survey BCR-1 and W-1; International Atomic Energy Agency Soil-5; and National Bureau of Standards coal, fly ash, and orchard leaf). The results in the vast majority of cases agree very well with reported values. 3 figures, 2 tables.

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 13115, 13524

13947 (K—2012) In-situ analysis for volatile constituents in 14.7 kV power cable by purge and trap. Miller, M.S.; Morrow, R.W.; Wright, C.C.; Oldham, T.R. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 21 Dec 1979. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

A nondestructive in-situ analytical method to detect sulfur vulcanized rubber fillers in installed 15 kV power cables is described. The sulfur rubber fillers are corrosive to copper cable shielding rendering the power cables unfit for intended use. The analytical methodology involves purging the interstitial cable gases through a series of cryogenic traps and subsequent analyses by gas chromatography/mass spectrometry (GC/MS) or by direct gas mass spectrometry. A compound indicative of sulfur rubber fillers has been identified as carbonyl sulfide (COS). Pertinent sampling and analytical procedures are described and supportive analytical data are given.

13948 (LA—7981) Gravimetric determination of carbon in uranium-plutonium carbide materials. Kavanaugh, H.J.; Dahlby, J.W.; Lovell, A.P. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 12p. Dep. NTIS, PC A02/MF A01.

A gravimetric method for determining carbon in uranium-plutonium carbide materials was developed to analyze six samples simultaneously. The samples are burned slowly in an oxygen atmosphere at approximately 900°C, and the gases generated are passed through Schuetze's oxidizing reagent (iodine pentoxide on silica gel) to assure quantitative oxidation of the CO to CO_2. The CO_2 is collected on Ascarite and weighed. This method was tested using a tungsten carbide reference material (NBS-SRM-276) and a (U,Pu)C sample. For 42 analyses of the tungsten carbide, which has a certified carbon content of 6.09%, an average value of 6.09% was obtained with a standard deviation of 0.01% or a relative standard deviation of 0.28%. For 17 analyses of the (U,Pu)C sample, an average carbon content of 4.97% was found with a standard deviation of 0.01% or a relative standard deviation of 0.24%.

13949 (INEL-tr—43) Determination of traces of impurities in beryllium and uranium by spark mass spectrometry. Bourguillot, R.; Cavard, A.; Cornu, A.; Stefani, R. Translated from *Chim. Anal.*

(Paris); **49**: No. 6, 315-319(Jun 1967). 7p. Dep. NTIS, PC A02/MF A01.

Spark mass spectrometry allows analysis of traces in metals in the range of parts per million. It has been successfully applied to very different metals, such as beryllium and uranium, and produces, without a standard, a semi-quantitative determination of all the impurities. For some elements comparison with other analytical methods produced sensitivity coefficients which allow improvement of the accuracy of the results.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 13183, 13191, 13933, 13935, 13936, 14230

13950 (AD-A—062792) **Application of energy dispersive x-ray fluorescence spectroscopy to the analysis of contaminants in fuels and lubricants. Interim report.** Greenberg, M.K.; Newman, F.M. (Southwest Research Inst., San Antonio, TX (USA). Army Fuels and Lubricants Research Lab.). Nov 1978. Contracts DAAG53-76-C-0003;DAAK70-78-C-0001. 14p. NTIS, PC A02/MF A01.

A rapid and inexpensive x-ray fluorescence spectroscopic method for the analysis of particulate contaminants has been developed. The method employs the collection of the particulates by filtration followed by x-ray fluorescence analysis of the filter. A unique method for the preparation of standard materials on filters for calibration of the x-ray spectrometer has been developed. Linear response over 2 orders of magnitude is routine. The sensitivity is in the parts per million range. The precision and accuracy is about 3 to 5 percent. The method is currently being used to determine contamination in fuels and to correlate the contamination and wear metal particulates in lubricants with engine wear. A large number of turbine fuels and lubricants have been analyzed and the data obtained have correlated to field performance.

13951 (EGG-PHYS—5058) **Liquid scintillation alpha particle spectrometry. Progress report.** Bell, L.L.; Hakooz, S.A.; Johnson, L.O.; Nieschmidt, E.B.; Meikrantz, D.H. (Idaho National Engineering Lab., Idaho Falls (USA); Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Dec 1979. Contract EY-76-C-07-1570. 72p. Dep. NTIS, PC A05/MF A01.

Objective to develop a technique whereby Pu may be put into solution, extracted by solvent extraction into a suitable extractive scintillant and subsequently counted. Presented here are results of attempts to separate beta and alpha activities through pulse shape discrimination. A qualitative discussion is given which yields alpha particle peak widths, resolution and response. The detection efficiency for alpha particles in a liquid scintillant is 100%. Present detection sensitivities of the equipment being used are: 4.5×10^{-6} μCi (100 s), 1.2×10^{-6} μCi (1000 s), and 4.0×10^{-7} μCi (10,000 s) at the 3 σ level. The detectability of a particular alpha-emitting species is strongly dependent upon the population of other species. The ability to discriminate depends upon the system resolution. 14 figures, 2 tables.

13952 (GJBX—4(80)) **High resolution gamma-ray spectroscopy applied to bulk sample analysis.** Kosanke, K.L.; Koch, C.D.; Wilson, R.D. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jan 1980. Contract EY-76-C-13-1664. 62p. Dep. NTIS, PC A04/MF A01.

A high resolution Ge(Li) gamma-ray spectrometer has been installed and made operational for use in routine bulk sample analysis by the Bendix Field Engineering Corporation (BFEC) geochemical analysis department. The Ge(Li) spectrometer provides bulk sample analyses for potassium, uranium, and thorium that are superior to those obtained by the BFEC sodium iodide spectrometer. The near term analysis scheme permits a direct assay for uranium that corrects for bulk sample self-absorption effects and is independent of the uranium/radium disequilibrium condition of the sample. A more complete analysis scheme has been developed that fully utilizes the gamma-ray data provided by the Ge(Li) spectrometer and that more properly accounts for the sample self-absorption effect. This new analysis scheme should be implemented on the BFEC Ge(Li) spectrometer at the earliest date.

13953 (LA—8146-MS) **Plutonium solution assay system based on high-resolution gamma-ray spectroscopy.** Parker, J.L. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 16p. Dep. NTIS, PC A02/MF A01.

An automated, nondestructive assay system for plutonium solution samples has been designed, constructed, and tested. The assay system is based on high-resolution gamma-ray spectroscopy of the naturally emitted plutonium gamma rays. The assays are made on 20- to 30-ml samples over a wide range of plutonium concentration (~ 0.5 g Pu/l to ~ 500 g Pu/l) with 1-sigma precision of generally ≦ 1% for ^{239}Pu, ^{241}Pu, and ^{241}Am in assay times of 45 min or less. When properly calibrated, bias and/or systematic error is ≦ 1% over the range of concentration, and the assay procedure is insensitive to the chemical composition of the solutions. The system employs a very high resolution, moderately efficient lithium-drifted germanium gamma-ray detector to optimize the accurate extraction of the required information from the complex plutonium spectra. Also critical to the assay accuracy is the correction for sample self attenuation (based on transmission measurement through the sample by an external plutonim source) and the correction for pileup and deadtime losses (based on the constant 88.0 keV flux from a small, fixed ^{109}Cd source). Once set up and running the system is easily operated by relatively untrained personnel and the system control codes have many internal checks on the system performance and assay precision.

13954 Determination of Strontium-89 and -90 in soil with total sample decomposition. Martin, D.B. (Department of Energy, Idaho Falls, ID). *Anal. Chem.;* **51**: No. 12, 1968-1972(Oct 1979).

Potassium fluoride and pyrosulfate fusions of soil guarantee strontium is in the ionic state. After dissolving the fusion cake, strontium sulfate is coprecipitated with lead and calcium which are preferentially dissolved into EDTA and discarded. Subsequently, strontium sulfate is dissolved in EDTA and hydrolytic elements are separated on ferric hydroxide. Strontium sulfate is precipitated from EDTA at a lower pH, dissolved in DTPA, and set aside for ^{90}Y ingrowth. After ingrowth the strontium sulfate is reprecipitated, and the ^{90}Y is extracted from the supernate into bis(2-ethyhexyl) phosphoric acid. When both ^{89}Sr and ^{90}Sr are being determined, barium chromate is separated from a DTPA solution of strontium. Strontium sulfate is precipitated from the barium chromate supernate and counted for ^{89}Sr plus ^{90}Sr. Yttrium-90 is counted on yttrium oxalate to determine ^{90}Sr, and ^{89}Sr is determined by difference. Precision, accuracy, sensitivity, and the effects of interferences are discussed. 4 tables, 1 figure.

13955 Simultaneous determination of alpha-emitting radionuclides of thorium and plutonium in human tissues including bone. Singh, N.P.; Ibrahim, S.A.; Cohen, N.; Wrenn, M.E. (New York Univ. Medical Center, NY). Contract EY-76-5-02-2968. *Anal. Chem.;* **51**: No. 12, 1978-1981(Oct 1979).

A method has been developed for the simultaneous determination of environmental, i.e., non-occupational, levels of α-emitting isotopes of thorium and plutonium in human lung, lymph nodes, liver, kidney, thyroid, spleen, gonads, and bone. Known amounts of soft tissues (5-850 g) spiked with 1-2 dpm tracers of ^{229}Th and ^{242}Pu are wet ashed with nitric acid, and H_2SO_4 with occasional addition of HNO_3 and H_2O_2. Th and Pu are coprecipitated with 10 mg of Fe carrier by gradual addition of ammonium hydroxide. The precipitate is dissolved in HNO_3 and adjusted to 4 M. Th and Pu are coextracted into 25% (v/v) trilaurylamine in xylene. Th is backwashed with 10 M HCl and the Pu is back-extracted with 2 M H_2SO_4. Th and Pu are electrodeposited separately on platinum planchets and determined by α spectrometry. Bone samples are wet ashed with nitric acid and H_2O_2, after spiking with ^{229}Th and ^{242}Pu tracers. Th and Pu are coprecipitated with calcium oxalate by adding oxalic acid. The precipitate is heated at 550°C, dissolved in nitric acid, and adjusted to 4 M. Then extractions, back-extractions, electrodeposition and measurements are performed as described for soft tissues. The recovery for Th ranged from 30 to 93% with a mean of 55% and for Pu from 32 to 94% with a mean of 71%. 4 figures, 2 tables.

13956 Computer techniques for analysis of gamma-ray spectra. Gunnink, R. (Univ. of California, Livermore). pp 109-138 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

This paper provides an overview of computer methodology used to reduce and interpret spectral data. Elements and problems associated with the process of reducing the data to entities that are physically more meaningful, such as gamma-ray energies and intensities, are discussed. Equal emphasis, however, is given to computer approaches for interpreting these quantities in the analytical sense of disintegration rates, atoms, or grams of specific nuclides or materials. Finally, some special-purpose techniques involving computer-generated response spectra are described. 18 figures.

13957 Linear least-squares peak-search algorithm. Bauer, T.L.; Draper, E.L. Jr. (Univ. of Texas, Austin). pp 157-165 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A method that locates and estimates peak parameters without requiring prior specification of peak width has been developed. Successive applications of linear least-squares analysis are performed to calculate peak location, width, and height. Only a single initial parameter, to smooth and locate potential peak data, is required and is relatively insensitive to peak width. The algorithm, programmed in FORTRAN-IV and operating on a Nova 800 minicomputer, can

locate nearly 150 peaks in a 4096-channel Ge(Li) detector spectrum at a rate faster than 1000 channels/min. Results are compared with an alternative analysis. Major effects of deviations of the data from assumptions of the analysis method have been examined. 3 figures.

13958 Direct measurement of net peak areas in energy-dispersive x-ray fluorescence. Nielson, K.K.; Wogman, N.A. (Battelle Pacific Northwest Labs., Richland, WA). pp 166-176 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Modifications of Covell's peak-analysis method have resulted in a direct method for obtaining reliable net peak areas from energy-dispersive X-ray fluorescence spectra. The method is independent of linear spectral background and peak shape, it avoids errors from gain shifts, and it provides a convenient technique for correction of peak overlap errors. Net areas have approximately twice the relative uncertainty estimated for the total net area of an isolated peak, but they may be determined in crowded X-ray spectra which have few interpeak regions for background definition. Since no subjective judgments are required, the method is ideally suited to computerized spectral analysis.

13959 Development of a program for reduction of large numbers of gamma-ray spectra. Maddison, D.W. (Argonne National Lab., Idaho Falls, ID). pp 230-237 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A program has been developed for processing large numbers of gamma-ray fission-product spectra accumulated from Ge(Li) detector systems. The processing of 5000 spectra per week is possible on a routine basis to determine fission and capture rates in critical reactor assemblies. Special techniques were developed to provide data consistency and rapid processing. Comparison of results with calculation indicates reasonable agreement with uncertanties of 1%.

13960 Computer code for qualitative analysis of gamma-ray spectra. Yule, H.P. (eds.). (NUS Corp., Rockville, MD). pp 278-296 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Computer code QLN1 provides complete analysis of gamma-ray spectra observed with Ge(Li) detectors and is used at both the National Bureau of Standards and the Environmental Protection Agency. It locates peaks, resolves multiplets, identifies component radioisotopes, and computes quantitative results. The qualitative-analysis (or component identification) algorithms feature thorough, self-correcting steps which provide accurate isotope identification in spite of errors in peak centroids, energy calibration, and other typical problems. The qualitative-analysis algorithm is described in this paper.

13961 Multi-user minicomputer system for gamma-ray spectroscopy and laboratory programming. Hagenauer, R.C. (New Brunswick Lab., Argonne, IL). pp 395-400 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A DEC PDP-15 computer-based multichannel analyzer that was expanded to a multi-user large minicomputer system serves as the primary data-procesing system for a chemistry laboratory, a real-time multichannel analyzer, and a host computer for several off-line multichannel analyzers. The advantages and disadvantages of developing a multichannel analyzer as part of a multi-user system are discussed. Also discussed are the limitations of using a host computer by an off-line multichannel analyzer.

13962 Least-squares method for computing nuclide concentrations from environmental gamma-ray spectra. Sanderson, C.G. (Environmental Measurements Lab., New York, NY). pp 441-447 of Computers in activationa analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

NUCAL is a computer program that converts the gamma-ray line intensities obtained with a Ge(Li) detector to nuclide concentrations by a least-squares method. The required input to the program consists of the line energy, the correspondng count rate and counting error, detector identification, sample weight, and sample geometry. A gamma-ray reference library, a working library, and the coefficients of polynomial efficiency curves recorded on a mass storage device provide program support. The output provides a list of gamma-ray lines not used in the least-squares analysis, the lines actually used, the original intensities, the calculated intensities, their difference and statistical variation, and, finally, the nuclide identification and disintegration rate. 5 tables.

13963 Computerized radionuclidic analysis in production facilities. Gibbs, A. (Savannah River Plant, Aiken, SC). pp 530-534 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

The Savannah River Plant Laboratories Department has been using a dual computer system to control all radionuclidic pulse-height analyses since 1971. This computerized system analyzes 7000 to 8000 samples per month and has allowed the counting room staff to be reduced from three persons to one person. Process information being returned to the production facilities and for environmental evauations is more reliable and is being returned faster, even though the sample load has more than tripled. This information is now more easily retrieveable for other evaluations. The computer is also used for mass-spectrometer data reduction and for quality-control data analysis. The basic system is being expanded by interfacing microcomputers, which provide data input from all the laboratory modules for quality-assurance programs.

13964 Programmable calculator: alternative to minicomputer-based analyzer. Hochel, R.C. (Savannah River Lab., Aiken, SC). pp 582-590 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Described are a number of typical field and laboratory counting systems that use standard stand-alone multichannel analyzers (MCA) interfaced to a Hewlett-Packard Company (HP 9830) programmable calculator. Such systems can offer significant advantages in cost and flexibility over a minicomputyr-based system. Because most laboratories tend to accumulate MCA's over the years, the programmable calculator also offers an easy way to upgrade the laboratory while making optimum use of existing systems. Software programs are easily tailored to fit a variety of general or specific applications. The only disadvantage of the calculator vs a computer-based system is in speed of analyses; however, for most applications this handicap is minimal. Applications discussed give a brief overview of the power and flexibility of the MCA-calculator approach to automated counting and data reduction.

13965 Elemental analysis of planetary surfaces via orbital gamma-ray spectroscopy. Reedy, R.C. (Univ. of California, Los Alamos, NM). pp 684-697 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Orbital gamma-ray spectroscopy can determine the chemical composition of planets with little or no atmosphere and provides valuable clues to the planet's origin and evolution. The strongest gamma-ray lines emitted from a planetary surface include those from the decay of the natural radioelements potassium, uranium, and thorium and those from nonelastic-scattering and neutron-capture reactions by cosmic-ray particles. The distributions of potassium, thorium, iron, magnesium, and titanium for 20% of the moon were mapped by NaI(Tl) spectrometers flown on the Apollo 15 and Apollo 16 missions. Backgrounds in the Apollo spectra included cosmic gamma rays, radioactivity in the spacecraft and detector, electron bremsstrahlung, and nuclear reactions in the matter surrounding the detector. Only about 15% of the photons from the lunar surface were gamma-ray lines that had not undergone interactions; the remainder formed a continuum that had to be determined and removed from a lunar spectrum before the discrete line spectrum could be unfolded. Solid-state gamma-ray spectrometers of high-purity germanium are proposed for future orbiters to Mars and the moon. 3 figures.

13966 Computer-controlled remote gamma-ray spectrometer. Nieschmidt, E.B.; Coates, R.A.; Johnson, L.O.; Killian, E.W. (Idaho National Engineering Lab., Idaho Falls). pp 698-707 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

The nuclear-power industry must monitor various effluents of power plants as well as plant operations. Programs under way at INEL to meet these objectives require the use of several remote, real-time, gamma-ray-spectrometer systems. Measurements performed by these systems include radioactive-effluent monitoring,

irradiated reactor-fuel scanning, fission-product analysis for fuel condition, and monitoring of plant operations. It was decided to develop a standardized data-accumulation system having significant flexibility to meet all objectives and allowing development and training costs to be shared by the various programs. The development of such a standardized system requires a reliable method of data accumulation remote from a control computer system which has the responsibility for verification, analysis, and interpretation of the data. In the designing of such a system, three goals were established: (1) the data accumulation and transfer of data must be completely automated and under control of a central processor, (2) the remote system must be able to monitor and verify its own operation, and (3) the remote system must be able to control external devices. The development of a remote analyzer system that would meet all required goals was carried out in three phases: (1) implementation of a commercial hard-wired analyzer that could be controlled remotely via commands received from a central computer; (2) implementation of a minicomputer as the controlling device for the analyzer system in which the computer receives and interprets commands from the central computer and performs the required functions; (3) incorporation of all functions developed for phase 2 in a microcomputer-controlled system (currently in progress).

13967 Computer-controlled four-detector gamma-ray counting system. Maddison, D.W. (Argonne National Lab., Idaho Fall, ID). pp 708-716 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A computer-controlled gamma-ray counting system developed to accommodate large numbers of fission foils is described. A small, general-purpose computer provides all the functions of data acquisition, from analog-to-digital inputs to data display and data outputs, as well as complete system control. Each of the four Ge(Li) detector inputs operates independently. Special programming allows for simultaneous acquisition of four gamma-ray spectra of 8192 channels each with only a 12k-word 16-bit computer. Some provisions for interactive data manipulation are also provided.

13968 Minicomputer system for radiochemical analysis by coincidence spectrometry. Brauer, F.P.; Fager, J.E. (Battelle-Northwest, Richland, WA). pp 717-727 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Minicomputer-based coincidence analysis methods have been developed for use in performing radiochemical analysis by high-resolution x- and gamma-ray coincidence spectrometry. This paper describes the data-acquisition and analysis methods develolped for qualitative and quantitative analyses of coincidence spectrometric data. Data-acquisition capabilities include both direct multiparameter pulse-height analysis and buffered list-mode acquisition.

13969 Applications of in situ gamma-ray spectrometry. Ragaini, R.C.; Kirby, J.A. (Lawrence Livermore Lab., CA). pp 767-791 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Gamma-ray spectrometric methods using high-resolution Ge(Li) and high-purity germanium detectors have been used to quantify the concentrations and external exposure rates of radionuclides in the soil. These in situ methods have been used to study radionuclide deposition around nuclear power stations, the distribution of radionuclides at the Nevada Test Site, biogeochemical cycling of radionuclides, and the fate and impact of fallout radionuclides. In Lawrence Livermore Laboratory's environmental science program, we have been using portable gamma-ray-spectrometer systems for various kinds of in situ field measurements. These systems include (1) large-volume coaxial Ge(Li) detectors for terrestrial gamma-ray surveys at several sites, including preoperational nuclear power plants, and for real-time measurements of nuclear-reactor-plume isotopic exposure rates; and (2) planar, high-purity germanium detectors for mapping ^{241}Am and ^{239}Pu soil concentrations, particularly at the Nevada Test Site. These applications are discussed, and the methodology and techniques associated with in situ gamma-ray spectrometry are briefly described. 11 figures, 6 tables.

13970 Computer-controlled gamma-ray scanner for irradiated reactor fuel. Mandler, J.W.; Coates, R.A.; Killian, E.W. (Idaho National Engineering Lab., Idaho Falls). pp 792-800 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

Gamma-ray scanning of irradiated fuel is an important nondestructive technique used in the thermal fuels behavior program currently under way at the Idaho National Engineering Laboratory. This paper is concerned with the computer-controlled isotopic gamma-ray-scanning system developed for postirradiation examination of fuel and includes a brief discussion of some scan results obtained from fuel rods irradiated in the Power-Burst Facility to illustrate gamma-ray spectrometry for this application. Both burnup profiles and information concerning fission-product migration in irradiated fuel are routinely obtained with the computer-controlled system.

13971 Computer analysis and control for nondestructive gamma scanning of LMFBR fuel pins. Barnes, B.K.; Phillips, J.R.; Waterbury, G.R.; Quintana, J.N.; Murray, A.S.; Netuschil, J.R. (Univ. of California, Los Alamos, NM). pp 801-810 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A program to modernize existing computer control and data analysis in a precision gamma-scanning system is described. This involves interfacing a new computer-based multichannel analyzer to existing equipment through a CAMAC system with an intelligent crate controller and writing software for scan control and data reduction. Both hardware and software requirements are discussed. 6 figures.

13972 ANGEL: a conversational program for nuclear-fuel-element scanning by Ge(Li) gamma spectroscopy. Dyer, F.F. (Oak Ridge National Lab., TN). pp 811-819 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

ANGEL is a modular computer program written for the PDP-11/05-based Tennecomp Systems, Inc., model TP-5000 pulse-height-analyzer system to acquire and process high-resolution gamma spectra. The program was developed to accomplish both general-purpose spectroscopy and meet the special requirements of gamma scanning of nuclear-fuel-element components. Routines are provided to find photopeaks and determine their energies, count rates, and errors; identify radionuclides; and calculate activities. Corrections are made for gamma-ray attenuations in samples and for random coincidence counting losses in the amplifier. In its application to gamma scanning of fuel-element components, ANGEL acquires and records spectra synchronously with the real-time operation of an independently operating scanning apparatus. Spectra stored on magnetic tape are then processed on a nuclide-by-nuclide basis to form data files consisting of the distributions of activities vs distance along the fuel-element component. This method has been applied in a study in which some 9000 gamma spectra of high-temperature gas-cooled-reactor fuel elements were acquired and analyzed.

13973 Mobile computerized gamma-ray and x-ray spectrometric-analysis and data-processing system. Brauer, F.P.; Fager, J.E.; Kaye, J.H.; Sorenson, R.J. (Battelle-Northwest, Richland, WA). pp 820-827 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A mobile, computerized gamma-ray and x-ray spectrometric-analysis and date-processing system has been designed, assembled, and evaluated. The system consists of a specially constructed vehicle, multichannel analyzer, and data-processing equipment mounted in the vehicle and germanium detectors that can be moved to locations external to the vehicle for use. Applications of the system include nuclear-material safeguards measurement, in situ radionuclide analysis, activation analysis, and research support.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 12951, 13987, 14230

13974 Analysis of the spectrophotometric technique for the measurement of lanthanide and actinide ion densities in inorganic vapor complex systems. Hessler, J.P. (Argonne National Lab., IL). *J. Phys. Chem.*; **83**: No. 20, 2631-2634(4 Oct 1979).

The spectrophotometric technique is currently the only technique used to characterize the gas complexation reactions between lanthanide and actinide halides and group III halides. In several cases a temperature-dependent molar absorptivity has been observed. To explain this observation, a temperature-dependent line width and

ground state population distribution as well as the existence of several molecular species with different oscillator strengths are considered. Absolute ion densities are calculated, based upon the effective oscillator strength instead of the molar absorptivity. The assumptions necessary for the analysis of multispecies systems are stated. 1 figure.

13975 Selective heavy-atom perturbation for analysis of complex mixtures by room-temperature phosphorimetry. Vo-Dinh, T.; Hooyman, J.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Anal. Chem.;* **51**: No. 12, 1915-1921(Oct 1979).

The technique of selective external heavy-atom pertubation (SEHAP) is applied to improve room temperature phosphorescence (RTP) analysis of complex samples. It is demonstrated that heavy atoms can selectively increase the phosphorescence emission of specific components in mixtures. The usefulness of many heavy-atom perturbers has been investigated for a wide variety of polynuclear aromatic compounds of environmental interest in coal-derived products. The SEHAP technique extends the analytical possibilities of RTP analysis since targeted components in complex samples can be selectively monitored. 9 figures, 4 tables.

13976 Trifluoroacetyl chloride for characterization of organic functional groups by fluorine-19 nuclear magnetic resonance spectrometry. Sleevi, P.; Glass, T.E.; Dorn, H.C. (Virginia Polytechnic Inst. and State Univ., Blacksburg, VA). *Anal. Chem.;* **51**: No. 12, 1931-1934(Oct 1979).

The potential utility of trifluoroacetyl chloride as an analytical ^{19}F NMR reagent to characterize alcohols, phenols, thiols, and primary and secondary amines is reported. The ^{19}F chemical shift and yield data for trifluoroacetyl derivatives of approximately 50 model compounds are presented. The importance of an added organic base (2,6-lutidine) in derivative preparation for phenols and primary and secondary amines is discussed. 3 figures, 2 tables.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 14242

13977 (UCD—472-125, pp 168-169) **More sensitive method for liquid scintillation assay of ^{222}Rn in aqueous samples.** Parks, N.J. Oct 1979.

In Annual report, 1978-1979.

Experiments indicated that a variation of the isopiestic method from solution thermodynamics is a useful technique for conventional liquid scintillation detection of radon in water samples containing less than 1 fCi/cm^3. The isopiestic method removes the restriction imposed by the counting-vial volume on the maximum volume of water which can be assayed.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 13974, 14158

13978 (AD-A—062951) **How carbon monoxide bonds to alumina-supported rhodium particles: tunneling spectroscopy measurement with isotopes. Technical report.** Kroeker, R.M.; Kaska, W.C.; Hansma, P.K. (California Univ., Santa Barbara (USA). Quantum Inst.). Nov 1978. Contract N00014-78-C-0011. 25p. NTIS, PC A02/MF A01.

Carbon monoxide chemisorbs in at least three different ways on alumina-supported rhodium particles: There are two different linear-bonded species and at least one bridge-bonded species. These conclusions from tunneling measurement on a model catalyst surface are based on isotope shifts with CO13 and C(18)O. They are in agreement with the conclusions from infrared measurements on dispersed metal catalysts.

13979 (GEPP-TIS—470) **Cyanide evolution from a potassium gold cyanide plating bath.** Antepenko, R.J. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 12 Feb 1980. Contract EY-76-C-04-0656. 12p. Dep. NTIS, PC A02/MF A01.

When a gold plating console was installed in a production area at the General Electric Neutron Devices Department (GEND), the console was placed adjacent to a 10% H_2SO_4 activation bath. An experiment was made to measure the amount of hydrogen cyanide gas released as a result of the accidental addition of sulfuric acid to the gold bath. Similar hydrogen cyanide gas evolution data were obtained from the addition of either dilute sulfuric acid or concentrated sulfuric acid. Results show hydrogen cyanide gas release was a function of the plating bath pH. Air samples collected over a portion of the gold bath at pH 5.6 and at either room temperature or at a 70°C operating temperature were found to contain 2 μg/l hydrogen cyanide. Air samples collected over the bath sample at pH 4.1 to 4.3 contained 40 μg/l hydrogen cyanide. A rapid increase in hydrogen cyanide was found in air samples collected over plating bath samples below pH 2.5. A quantity of reagent grade concentrated sulfuric acid was added to the test bath, which was equivalent to the addition of a 9-pound bottle of the acid to the 30-gallon production bath. Air samples were found to contain 1400 μg/l of hydrogen cyanide.

13980 (ISM—255) **Mixed-valency in discrete and condensed transition metal cluster species with classical ligands.** McCarley, R.E. (Ames Lab., IA (USA)). 1979. Contract W-7405-ENG-82. 42p. (CONF-7909117—1). Dep. NTIS, PC A03/MF A01.

From NATO-ASI on mixed valence compounds in chemistry conference; Oxford, UK (10 Sep 1979).

This paper summarizes and illustrates structural and bonding features of mixed-valence cluster compounds with emphasis on most recent developments. All cluster types from dimers through units with twelve metal atoms are surveyed among compounds with discrete cluster units. Some principles also are discussed relating extended, metal-metal bonded systems to the condensation of cluster units. Condensation of octohedral cluster units to form infinite chains, sheets and three dimensional metal-metal bonded systems is viewed from the perspective of the sharing of metal atoms on corners, edges and faces between adjacent units in the condensed systems. 74 references, 11 figures, 4 tables.

13981 (LBL—9885) **Tensi-volumetric studies of the $CaCO_3$-CaO-CO_2 system.** Shukla, R.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 149p. Dep. NTIS, PC A07/MF A01.

Thesis.

A tensi-volumetric apparatus was developed and used to study two aspects of the CaO-CO_2-$CaCO_3$ system, namely the thermodynamics of the $CaCO_3$ (calcite) phase viewed as a pseudo-binary solid solution of CaO and CO_2, and the kinetics of decomposition of $CaCO_3$ (calcite). The solubility of CO_2 in the calcite ($CaCO_3$) phase was studied as a function of pressure and temperature. It is shown that it is possible to obtain calcite of substoichiometric compositions expressed by [CaO x (CO_2)/sub 1-δ], where at the temperatures of measurement, 773°K to 1000°K, δ is a small, but measurable quantity. The composition limits of this phase increase rapidly with temperature. Calcite decomposition rates were measured in the range of P//sub Peq/ from 0.05 to about 0.8 and in the temperature range of 853° to 933°K. The decomposition rate changed by about three orders of magnitude in this range of P//sub Peq/ at every temperature of study. Decomposition rates of calcite powder depend on particle size, powder bed depth and compactness of samples. Measurements with single crystals of calcite suggest that at least two different processes limit the decomposition rate in different P//sub Peq/ regimes. The apparent activation enthalpy, ΔH/sup •/, for decomposition at P//sub Peq/ ≦ 0.1, calculated in terms of decomposition fluxes, is about 49.2 +- 1.2 K cals mole^{-1}. At values of P// sub Peq/ near unity, the value of ΔH/sup •/ rose to about 61.8 +- 1.8 K cals mole^{-1}. Decomposition rates for powders did not show a consistent apparent activation enthalpy over the range of P//sub Peq/ studied; they varied between 65 and 80 K cals mole^{-1}.

13982 (ORNL—5623) **Solubility of gibbsite (α - $Al(OH)_3$) in 1 molal NaCl as a function of pH and temperature.** Hitch, B.F.; Mesmer, R.E.; Baes, C.F. Jr.; Sweeton, F.H. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 35p. Dep. NTIS, PC A03/MF A01.

Discussed are the advantages and disadvantages of the column approach to study the pH dependence of the solubility of well crystallized hydroxides, and preliminary results on gibbsite ($Al(OH)_3$) are presented. Good results have been obtained in the basic region, and the temperature dependence of the equilibrium quotient for the reaction $Al(OH)_3(c) + OH^-$ reversible $Al(OH)_4^-$ in 1M NaCl is given by log Q/sub s14//sup b/ = 3.3766 - 1326.4/T with an agreement factor of 0.035 (unit weights). These measurements were made over the temperature range 35 to 90°C at the base concentrations of 0.01 M and 0.1 M NaOH. The principal difficulty with the column approach is the strong buffering capacity of the column itself for equilibrations in the near neutral pH region. We found that the capacity could be accounted for in terms of monolayer adsorption (or reaction) of H^+ ions. Although insufficient evidence for equilibrium was obtained, data in the pH range 3 to 4 give the value of -7.20 +- 0.15 at 60°C for the log Q/sub s10/ for the reaction $Al(OH)_3(c) + 3H^+$ reversible $Al^{3+} + H_2O$. Results of solubility measurements in the near neutral region are preliminary. 8 figures, 4 tables.

13983 Isopiestic compositions of aqueous ionic surfactant systems as a measure of preferential interactions. Application to the determination of micelle aggregation numbers by equilibrium ultracentrifugation. Doughty, D.A. (Dept. of Energy, Bartlesville, OK). *J. Phys. Chem.;* **83**: No. 20, 2621-2628(4 Oct 1979).

The determination of reliable micelle aggregation numbers for ionic surfactants by means of equilibrium ultracentrifugation requires

a correction for the preferential interactions which occur in multicomponent charged systems. Isopiestic distillation experiments on solutions containing the volatile solvent and the nonvolatile supporting electrolyte and varying amounts of the ionic surfactant lead directly to the desired correction for preferential interactions. Results for the surfactant, sodiumn dodecyl sulfate (SDDS), in various NaCl(aq) background solutions show that a substantial correction, increasing with increasing NaCl concentration, is required. Results on the surfactant, sodium decylsulfonate (SDS), show a smilar correction above the critical micelle concentration (cmc). Data for SDS below the cmc show a much different trend from that above, a condition not evident with SDDS because of the much lower cmc. If the interaction is interpreted as arising strictly from micelle charge, values for the micelle charge can be obtained. Sedimentation equilibrium experiments on SDDS in NaCl(aq) solutions gave aggregation numbers in good agreement with published values though generally higher. These higher results are consistent with the more reliable corrections for charge effects or preferential interactions available from the isopiestic distillation experiments. The aggregation numbers for SDDS increased with increasing NaCl concentration, consistent with published results. Precision density measurements, using a magnetic float densimeter having a precision of 1 ppM, were used to obtain accurate values for the partial specific volumes (anti ν) of SDDS in NaCl(aq) and water for use in the ultracentrifuge calculations. The results show a slight increase in anti ν with NaCl concentration. Values for the cmc obtained from the density measurements are in excellent agreement with published values. 3 figures, 2 tables.

13984 Theoretical computations of spontaneous vibration-rotation Raman scattering from OH(X^2II) and NO(X^2II). Miller, J.A.; Coll, C.F.; Melius, C.F. (Univ. of California, Livermore). *J. Quant. Spectrosc. Radiat. Transfer;* **21**: No. 3, 193-211(1979).

Absolute values of Q-branch line intensities for OH(X^2II) and NO(X^2II) have been calculated, primarily for use in making measurements in flames. The effects of spin-orbit interaction, spin uncoupling, vibration-rotation interaction, and anharmonicity has been included in the calculations simultaneously in a self-consistent fashion. A-doubling is neglected. Multiconfigurational self-consistent field calculations of static polarizabilities are used to approximate the required electronic matrix elements. Complete derivations and discussion of the wave functions and matrix elements are included for clarity and to point out restrictions and approximations. Results of the calculations for NO agree well with room temperature measurements of Raman cross sections. No experimental data are available for OH. 1 figure, 9 tables.

13985 Potential energy surfaces for fluorine-hydrogen systems. Bender, C.F. (Univ. of California, Livermore); Schaefer, H.F. III. Contract W-7405-ENG-48. pp 283-295 of Fluorine-containing free radicals: kinetics and dynamics of reactions. Root, J.W. (ed.). Washington, DC; American Chemical Society (1978).

From 169. national meeting, American Chemical Society; Philadelphia, PA, USA (6 Apr 1975).

Ab initio molecular electronic structure theory has now progressed to the point where it is capable of making genuine contributions to the understanding of simple chemical reactions. Especially noteworthy examples are the elementary fluorine hydrogen reactions pertinent to the HF chemical laser. The present paper discusses the reactions $F + H_2 \rightarrow FH + H$, $H + FH \rightarrow HF + H$, $H + F_2 \rightarrow HF + H$, and $F + HF \rightarrow FH + F$, with particular emphasis on the relationships between ab initio theory and experiment. Directions for future research are suggested.

ISOTOPE EFFECTS

13986 (DOE/ER/10425—01) **Variational transition state theory. Progress report, July 1, 1979-June 30, 1980.** Truhlar, D.G. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry). Feb 1980. Contract AC02-79ER10425. 10p. Dep. NTIS, PC A02/MF A01.

The variational transition state theory (VTST) of chemical reaction rates has been further developed and two previously developed and one new version have been illustrated and tested by various applications to collinear and three-dimensional reactions of the type $A + BC \rightarrow AB + C$. The first two versions considered are canonical variational theory (CVT), which is based on curves of free energy of activation as functions of location of the VTST dividing surface, and microcanonical variational theory (μVT), which is based on minimizing the reactive flux through the VTST dividing surface at each total energy. CVT is simpler but μVT is more accurate. The new theory, improved canonical variational theory (ICVT), is almost as simple as CVT but almost as accurate as μVT. This has been demonstrated by applications to H, O, F, Cl, and I reacting with H_2, H reacting with F_2 and Cl_2, and various isotopic analogs and model systems. It was also demonstrated that VTST leads to very good agreement with accurate quantal results for several collinear reactions. Another project used VTST to explore the systematics of kinetic isotope effects for three-dimensional reactions. The predictions sometimes differ considerably from those of the conventional theory.

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 12981

13987 Mass spectrometry of N-nitrosamines. Rainey, W.T.; Christie, W.H.; Lijinsky, W. (Oak Ridge National Lab., TN). *Biomed. Mass Spectrom.;* **5**: No. 6, 395-408(1978).

The preparation of a series of N-nitrosamines for carcinogenicity studies presented an opportunity to study mass spectral fragmentation schemes in detail. Condensed spectra are listed for 146 N-nitrosamines of widely differing structures, including nitroso derivatives of commercial drugs and insecticides. Aliphatic nitrosamines were generally characterized by molecular ions and loss of OH. Subsequent fragmentation via α-cleavage is similar to that of aliphatic amines. The loss of OH is believed to result in a cyclic ion. Substituted aliphatic nitrosamines varied in fragmentation schemes with structure and position of the substituent groups. However, most showed α-cleavage at some point in fragmentation. When substituted with aromatic groups, prominent peaks due to the aromatic moiety were observed. The alicyclic nitrosamines showed losses of NO, NOH and OH and subsequent α-cleavages. Nitrosamides were characterized by rupture of the carbonyl to nitrogen bond. Spectra of substituted ureas usually showed charge retention by the carbonyl fragment, while carbamate esters showed ions from both fragments. 4 figures, 2 tables.

13988 (UCRL—15165) **Calorimetric studies of the TATB-polymer-H_2O system. Final report.** Eatough, D.J.; Christensen, J.J.; Collins, S.G. (Brigham Young Univ., Provo, UT (USA). Thermochemical Inst.). 31 Dec 1979. Contract W-7405-ENG-48. 40p. Dep. NTIS, PC A03/MF A01.

Interaction of TATB with polymer increases in the order Phenoxy < Kel F < Kraton with respect to ΔH values for the interaction in toluene, end point for addition of polymer to TATB, and hydration by water. Hydration of a mixture of TATB and polymer is different from hydration of either alone. This suggests formation of complexes containing water-TATB-polymer.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 13993

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 13200

13989 (LBL—9565) **Flow-through porous electrodes.** Trainham, J.A. III. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 242p. Dep. NTIS, PC A11/MF A01.

Thesis.

The analysis and behavior of flow-through porous electrodes operating above and below the limiting current are the subjects of this dissertation. First, the minimum concentration attainable in a flow-through porous electrode is estimated by applying the thermodynamics of electrochemical cells with a knowledge of the maximum operating potential. Second, a one-dimensional model for flow-through porous electrodes operating above and below the limiting current of a metal deposition reaction is developed. Third, preliminary data on mercury removal from a sodium chloride brine using a flow-through porous carbon electrode show that this process has great potential. The mercury concentration was reduced from approximately 600 mg/l in the feed to less than 0.1 mg/l in the dilute product stream. Finally, an economic comparison is made between two electrode configurations for flow redox battery applications: (i) the flow-through configuration (current parallel to the fluid flow) and (ii) the flow-by configuration (current perpendicular to the fluid flow). Optimization results show that the flow-by configuration is superior. The flow-through configuration not only yields a lower return on investment, but it is impractical due to a requirement of extremely low flow rates ($Re < 0.001$). Its failure is due to current flow (and ohmic potential drop) in the same direction as the fluid flow. (DLC)

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 14255

13990 (COO—2026-39) **Studies in chemical reactivity. Progress report, January 1-December 31, 1979.** Carr, R.W. Jr. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science). Dec 1979. Contract EY-76-S-02-2026. 15p. Dep. NTIS, PC A02/MF A01.

Data on the collisional deactivation of chemically activated polyatomic molecules show a trend of decreasing $<\Delta E>$, the average energy removal per gas kinetic collision, with increasing size of activated molecule when polyatomic collider species of similar molecular structure and nearly constant number of atoms are used. Calculations of $<\Delta E>$ by a quasistatistical transition modes model give quantitative agreement with the experimental data. Measurements of photoionization cross sections and yields of some organic molecules have been made in a double ionization chamber. Work is proceeding on an experiment to detect chemically ativated molecules by photoionization. Observations have been made of the production of CF_2 in the flash photolysis of 1, 3-dichlorotetrafluoroacetone, and the rate of removal of CF_2 by reaction. Observations have also been made on the production and removal of ClO when O_2 is present in the reaction. Analysis of reaction products from the steady illumination photolysis of 1, 3-dichlorotetrafluoroacetone and oxygen mixtures at 313 nm/have been done by gas chromatography, infrared spectrometry and mass spectrometry. Continued efforts to observe $CH_2(^1B_1) \rightarrow CH_2(A'_1)$ luminescence from photolysis of ketene, diazomethane and diazirine were unsuccessful. Investigation of the reactions of methylene by flash photolysis with time resolved mass spectrometry have been undertaken.

13991 (COO—2807-15) **Experimental investigation of the chemistry of excited states of rare gases. Fourth quarterly (and annual) progress report, July 15, 1978-October 15, 1978.** Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). Dec 1978. Contract EY-76-S-02-2807. 12p. Dep. NTIS, PC A02/MF A01.

A brief account is given of work on the quenching of XeF(B) and other excited rare-gas systems. A more detailed report is given of the studies of the vacuum uv photolysis of XeO_4 and reactions of $Xe(^3P_2)$ and $Ar(^3P_2)$ with XeO_4. (DLC)

13992 (COO—2807-17) **Experimental investigation of the chemistry of excited states of rare gases. Second quarterly progress report, January 15, 1978-April 15, 1979.** Setser, D.W. (Kansas State Univ., Manhattan (USA). Dept. of Chemistry). May 1979. Contract EY-76-S-02-2807. 8p. Dep. NTIS, PC A04/MF A01.

The reactions of $Kr(^3P_1)$ and $Xe(^3P_1)$ with halogen compounds, producing rare gas halides, was studied. Abstracts of two papers on excited rare gas states are included. (DLC)

13993 **Effects of molecular structure and temperature on the tunneling abstraction of D from C-D bonds by trapped H and D atoms in alkane glasses at 5-29 K.** Wang, H.Y.; Willard, J.E. (Univ. of Wisconsin, Madison). Contract EY-76-S-02-1715-A002. *J. Phys. Chem.;* **83**: No. 20, 2585-2588(4 Oct 1979).

The rates of the tunneling abstraction of D atoms from the C-D bonds of three alkane glasses at 5 to 29°K by trapped H or D atoms increase in the sequence 3-methylpentane-d_{14} < 3-methylheptane-d_{18} < methylcyclohexane-d_{14}. This parallels both the increasing density of the matrices and the increasing proportion of secondary + tertiary C-D bonds to primary C-D bonds. The apparent activation energy (E/sub A/) is < 100 cal mol^{-1} in every case. For H/sub tr/ it shows a unique reversal in sign, being positive from 18 to 29°K, zero from 10 to 18°K, and negative from 5 to 10°K. For D/sub tr/ it decreases below 18°K but does not pass through a minimum. The temperature region of the discontinuities of E/sub A/ is that in which both stabilization of van der Waals molecules of the type $H.C_6H_{14}$ and quenching of the torsional vibrations of the CD_3 groups are to be expected. The ratios of the rates of decay of H/sub tr/ to D/sub tr/, R(H/sub tr/)/R(D/sub tr/), are all 2.1 to 0.8 in 3MP-d_{14} and 3MHp-d_{18} at 5 to 29°K, but range from 30 at 5°K to 3 at 29°K in MCHx. 4 figures, 1 table.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 13148, 14379

13994 (COO—2086-90) **Radiolysis studies on reactive intermediates. Technical progress report, November 1, 1978-November 1, 1979.** Kevan, L. (Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry). Nov 1979. Contract EY-76-S-02-2086. 22p. Dep. NTIS, PC A02/MF A01.

Analysis methods for electron spin echo modulation patterns were improved and were used to determine the silver atom solvation structure in water and methanol and the geometry of solvated electrons in organic matrices. New evidence for presolvated electrons in polar matrices was obtained, and the mechanism of electron solvation in pure and in mixed matrices was clarified.

13995 (PNL-SA—7640) **Sterilizing radiation effects on selected polymers.** Skiens, W.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 18p. (CONF-7903108—1). Dep. NTIS, PC A02/MF A01.

From Symposium on radiation sterilization of plastic medical products; Cambridge, MA, USA (28 Mar 1979).

The mechanism of radiation effects and their industrial applications are discussed for the following classes of polymers: thermoplastics, thermosets, elastomers, films and fibers, and adhesives/coatings/potting compounds. 35 references, 3 tables. (DLC)

13996 **ESR-ENDOR study of α-D-glucopyranose single crystals x irradiated at 12 and 77°K.** Madden, K.P.; Bernhard, W.A. (Univ. of Rochester, NY). *J. Phys. Chem.;* **83**: No. 20, 2643-2649(4 Oct 1979).

Single crystals of anhydrous α-D-glucopyranose x irradiated at 12 and 77°K contain four free-radical species: two secondary alkoxy radicals centered at O-2, a primary hydroxyalkyl radical centered at C-6, and a secondary hydroxyalkyl radical centered at C-3. Structural considerations are discussed, and the radicals compared with four radicals found in single crystals of α-D-glucopyranoside x irradiated under similar conditions. 4 figures, 3 tables.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

REFER ALSO TO CITATION(S) 14275, 14276, 14277

13997 (EMSL-LV—0539-29) **Neptunium: a bibliographic reference.** Mosley, R.E. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). Jun 1979. Contract EY-76-A-08-0539. 127p. Dep. NTIS, PC A07/MF A01.

A comprehensive bibliograhy of the literature on the element neptunium published prior to January 1976 is presented. A short abstract is given for each listed reference, with a few exceptions. The references are divided into sections categorized as General, Man-Made Sources (Reactors), Man-Made Sources (Fuel Reprocessing), Chemistry (Solubility), Chemistry (Compounds), Chemistry (Isotopes), Analyses (Instrumental), Analyses (Chemical), Chemical (Animal), Biological (Effects), Biological (Animal-Metabolism-Retention), Biological (Air Movement), Biological (Human Inhalation), Measurement, and Dosimetry. The bibliography contains author and keyword indexes and was compiled to serve as a quick reference source for neptunium-related work. 184 citations.

13998 (EMSL-LV—0539-30) **Curium: a bibliographic reference.** (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.). May 1979. Contract EY-76-A-08-0539. 143p. Dep. NTIS, PC A07/MF A01.

A comprehensive bibliography of the literature on the element curium published prior to January 1976 is presented. A short abstract is given for each listed reference, with a few exceptions. The references are divided into sections categorized as General, Man-Made Sources (Reactors), Man-Made Sources (Fuel Reprocessing), Chemistry (Solubility), Chemistry (Compounds), Chemistry (Isotopes), Analyses (Instrumental), Analyses (Chemical), Chemical (Animal), Biological (Effects), Biological (Animal-Metabolism-Retention), Biological (Air Movement), Biological (Human Inhalation), Measurement, and Dosimetry. The bibliography contains author and keyword indexes, and was compiled to serve as a quick reference source for curium-related work. 185 citations.

HOT-ATOM CHEMISTRY

13999 **Reactions of radioactive ^{18}F with alkenes, alkynes, and other substrates.** Rowland, F.S.; Rust, F.; Frank, J.P. (Univ. of California, Irvine). Contract AT(04-3)-34. pp 26-58 of Fluorine-containing free radicals: kinetics and dynamics of reactions. Root, J.W. (ed.). Washington, DC; American Chemical Society (1978).

From 169. national meeting, American Chemical Society; Philadelphia, PA, USA (6 Apr 1975).

The technique of using thermalized ^{18}F atoms for the study of fluorine atom reactions has proven very useful with unsaturated hydrocarbons and halocarbons, providing data on mechanisms, relative rate constants and factors controlling such reactions. The characteristic difficulties of macroscopic ^{19}F chemistry are often avoided at tracer levels, and analysis by radio gas chromatography can be quite straightforward. However, experiments at pressures below 0.1 atm are relatively difficult, and most of the usual analytical methods are inapplicable at product mole fractions < 10^{-10}. Many other classes of compounds can be readily substituted for alkenes and alkynes with little variation in equipment and technique. The extension to study ^{18}F atom reactions with organometallic compounds is one example of the broad applicability of tracer ^{18}F studies. 57 references, 5 figures, 10 tables.

14000 Chemistry of high energy atomic fluorine: steady state kinetic theory model calculations for the $^{18}F + H_2$ reaction III. Grant, E.R.; Feng, D.F.; Keizer, J.; Knierim, K.D.; Root, J.W. (Univ. of California, Davis). Contract E-(04-3)-34. pp 314-346 of Fluorine-containing free radicals: kinetics and dynamics of reactions. Root, J.W. (ed.). Washington, DC; American Chemical Society (1978).

From 169. national meeting, American Chemical Society; Philadelphia, PA, USA (6 Apr 1975).

The potential content of atomic recoil experiments has been shown to include useful dynamical information. A central interpretive difficulty follows from the need for unique and accurate specifications of the reactant non-Boltzmann momentum distributions. Brief reviews are given of the theoretical progress achieved thus far toward the resolution of this problem and of those aspects of the steady state hot atom kinetic theory that are pertinent to modeling calculations. Detailed modeling results are presented for nuclear recoil ^{18}F atoms reacting with hydrogen in order to illustrate the level of dynamical understanding that can be obtained. Specific topics treated include the nature and significance of microscopic time dependent phenomena, the nature of the coupling between reactive cross section structure and energy ranges for hot atom reactions, and perturbations of hot reactive energy ranges by inert additives in mixture experiments. The remainder of this article is concerned with the theoretical analysis of nuclear recoil hot atom chemistry experiments. 80 references, 13 figures, 5 tables.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 14351, 14454

14001 (LBL—10292) **Preparation and spectroscopic properties of three new actinide (IV) borohydrides.** Banks, R.H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 209p. Dep. NTIS, PC A10/MF A01.

Thesis.

New tetrakis-borohydrides of Pa, Np, and Pu have been synthesized. The crystal structure of $Pa(BH_4)_4$ is isostructural to those of $Th(BH_4)_4$ and $U(BH_4)_4$ and is of the tetragonal space group $P4_22_12$, where a = 7.53 (3) A, c = 13.22 (5) A, and Z = 4. Its calculated density is 2.57 gm-cm^{-3}. $Pa(BH_4)_4$ is an orange, air-sensitive compound which is soluble in THF and sublimes at 55^0 in vacuum. Due to the thermal instabilities of $Np(BH_4)_4$ and $Pu(BH_4)_4$, their reaction temperatures are maintained at 0^0 and the compounds must be stored at low temperature. Low temperature x-ray diffraction studies have shown that $Np(BH_4)_4$ and $Pu(BH_4)_4$ are isomorphous and exhibit a unique crystal structure which is very similar to that of $Zr(BH_4)_4$. The details of this new structure were determined by single crystal x-ray diffraction methods at 130K for $Np(BH_4)_4$. Neptunium borohydride is monomeric and crystallizes into the tetragonal space group $P4_2/nmc$, where a = 8.559 (9) A, c = 6.017 (9) A, and Z = 2. The 12 coordinate Np atom is triply hydrogen-bridged bonded to four terminal BH_4^- groups disposed tetrahedrally around it giving Np-B distances of 2.46 (3) A. Solid-state, low temperature infrared (25-7400 cm^{-1}) and Raman (100-2600 cm^{-1}) spectra were taken for $Np(BH_4)_4$ and $Np(BD_4)_4$. A normal coordinate analysis was carried out using the assigned fundamental frequencies obtained from the spectra and determined a reasonable set of force constants and calculated values for the frequencies of the unobserved T_1 modes. Based on results of the analysis, isotopic impurity, overtone, and combination bands were identified in the infrared spectra.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 13047

14002 (AD-A—064111) **Sooting characteristics of liquid pool diffusion flames. Master's thesis.** Van Treuren, K.W. (Princeton Univ., NJ (USA). Dept. of Mechanical and Aerospace Engineering). Jul 1978. Contract F49620-78-C-0004. 111p. NTIS, PC A06/MF A01.

This investigation deals with a liquid fuel diffusion flame and examines the use of the smoke point test as a means of qualitatively measuring the ability of a fuel to produce soot relative to other fuels. Results indicate the necessity of controlling the initial conditions in order to obtain meaningful measurements. This thesis reports a new technique for the smoke point determination that has proved to be more accurate and reproduceable than previous methods. Recent studies indicate water addition in a premixed flame chemically suppresses soot formation. As a result, addition of water inside a diffusion flame is a likely direction to pursue. Both water in fuel emulsions and direct steam injection were used in the present investigation. The results indicate a dominant thermal effect and a possible secondary chemical effect of water on soot formation. Blending of various fuel types reveals the domination of an aromatic fuel over an aliphatic when determining a combined smoke point of the mixture. Applying this information to alternative hydrocarbon fuels, the oil shale and coal derived fuels, having a higher percentage of aromatics than conventional fuels, produce soot more readily than their petroleum derived counterparts. Testing of oil shale and conventional fuels supplied by the Air Force verifies this result.

14003 (BNL—51088) **Report on the combustion research contractors' meeting.** Klemm, R.B.; Muckerman, J.T. (eds.). (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract EY-76-C-02-0016. 67p. Dep. NTIS, PC A04/MF A01.

A total of 46 short papers or abstracts are included, arranged into sessions dealing with general and NSLS status, theory of reactivity and chemical dynamics in combustion, kinetics of combustion reactions, (two sessions), and laser diagnostics for high temperature and combustion systems. (DLC)

14004 (SAND—79-8285) **Fundamental combustion and diagnostics research at Sandia. Progress report, July-September 1979.** Hartley, D.L. (Sandia Labs., Livermore, CA (USA)). Dec 1979. Contract EY-76-C-04-0789. 39p. Dep. NTIS, PC A03/MF A01.

The combustion research at Sandia Laboratories sponsored by the Division of Basic Energy Sciences emphasizes basic research into fundamental problems associated with combustion. Special emphasis is placed on the development and application of advanced research methods. The overall program addresses: (1) detailed chemistry of combustion, (2) fundamental processes associated in laminar and turbulent flames, (3) development of research techniques specifically applicable to combustion environments, and (4) operation of the user-oriented Combustion Research Facility.

ENGINEERING

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 13728, 13762, 13787, 13794, 14034, 14140, 14141, 14142, 14145, 14146, 14147, 14152

14005 (AD-A—067230) **Excitation of modal fields in parallel-plate transmission line. Final report, 30 June 1976-31 December 1978.** Mittra, R.; Lee, S.W. (Illinois Univ., Urbana (USA). Electromagnetics Lab.). Feb 1979. 32p. NTIS PC A03/MF A01.

In this report we discuss the problem of source radiation in an open, parallel-plate waveguide of finite width. Such a structure is used as a simulator for testing EMP hardening of large systems such as aircrafts. A conventional approach to expanding the fields in an open waveguide of this type entails the use of the leaky-mode representation. Such a representation is an approximate one and, under certain situations, it is desirable to verify its accuracy. The solution derived in this report is a complete one and can be used to test the leaky mode representation.

14006 (ANL/MSD/FE—80-1) **Development of nondestructive evaluation techniques for high-temperature ceramic heat exchanger components. Ninth quarterly report, October-December 1979.** (Argonne National Lab., IL (USA)). Jan 1980. Contract W-31-109-ENG-38. 25p. Dep. NTIS, PC A02/MF A01.

Progress in developing and evaluating nondestructive methods for testing ceramic components for high-temperature heat exchangers is reported. The sensitivity of the ultrasonic bore-side probe was demonstrated for detection of 125-μm-deep circumferential EDM notches on ID and OD surfaces of sintered and siliconized tubes. The signal to noise ratios for the ultrasonic echoes are better than 10 to 1, beyond the initial expectations for detection of small reflectors. This results from focussing of the beam in the tube wall. Preliminary data were presented on microprocessor-controlled operation of the ultrasonic probe. Some problems involving the computer interfacing have to be resolved, but detection and recording of an EDM notch located was demonstrated. The acoustic microscope was modified to handle 30-MHz sound waves. This was done to improve the penetration ability of the sound in SiC tube walls. The modification results in less acoustic noise. The ability to detect a notch only 75 μm in width was demonstrated.

14007 (BDX—613-2311) **Electromechanical polishing of metal spheres.** Miller, N.E.; Engelhaupt, D.E. (Bendix Corp., Kansas City, MO (USA)). Dec 1979. Contract EY-76-C-04-0613. 9p. Dep. NTIS, PC A02/MF A01.

Equipment has been developed to electromechanically polish metal spheres. Mechanical polishing is accomplished by the action of three cup-shaped laps which rotate against the sphere. An abrasive slurry containing an electrolyte is continuously applied to the sphere and laps. Electrochemical etching is accomplished by applying a

positive potential to two of the laps and a negative potential to the third.

14008 (BDX—613-2376) **Mathematical model and the dynamic simulation of an electromechanical rotary device.** Emergy, J.D. (Bendix Corp., Kansas City, MO (USA)). Feb 1980. Contract EY-76-C-04-0613. 65p. Dep. NTIS, PC A04/MF A01.

A mathematical model of an electro-mechanical rotary device is presented. This device contains a rotor, stator, and two spring-loaded arms which restrict the rotor motion. The desired action is the alignment of the rotor and the consequent movement of the arms. The SLENOID computer program for calculating the magnetic torque, air gap permeance, spring torque, damping effects, and motion of the rotor and arms is described. (LCL)

14009 (COO—4649-8, pp 3-20) **Heat exchanger technology program of the US Department of Energy.** Thielbahr, W.H. Oct 1979.

In Research workshop on energy conservation through enhanced heat transfer.

US DOE-sponsored programs to improve the performance, reliability, and cost of heat exchangers are briefly reviewed. The overall Heat Exchanger Program, begun in 1976, now has a $2 million budget and has the potential of significantly contributing to industrial energy conservation. (LCL)

14010 (EPRI-WS—78-134, pp 5.35-5.45) **Digital pressure instruments for accuracy, convenience, and transmission.** Johnson, A.W. Nov 1979.

In Plant performance testing and evaluation workshop. Workshop proceedings.

Digital pressure measurement instruments can replace conventional dead weight gauges and manometers in making gauge, absolute, or differential pressure measurements in performance testing of instrument calibration. Optional output signals can be transmitted to computers or data acquisition instrumentation.

14011 (N—79-22434) **Cts-type variable conductance heat pipes for Sep FM/PPU. Final report, October 1977-December 1978.** Antoniuk, D.; Luedke, E.E. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Dec 1978. Contract NAS3-21130. 45p. NTIS PC A03/MF A01.

The development effort for, and the fabrication and testing of, six CTS-type variable conductance heat pipes is described. The heat pipes are constructed of stainless steel, use methanol as a working fluid, and a nitrogen/helium mixture as the control gas. The wicking structure consists of interior wall grooves, a metal-felt diametral slab wick, and two wire-mesh arteries. The heat pipes are used to cool two Functional Model/Power Processing Units in a Solar Electric Propulsion prototype BIMOD thruster subsystem assembly. The Power Processing Units convert the electric power from a spacecraft solar array system to the voltages required to operate the electric thrusters which are part of the BIMOD assembly.

14012 (ORNL/TM—5456) **Laboratory services series: a programmed maintenance system.** Tuxbury, D.C.; Srite, B.E. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 83p. Dep. NTIS, PC A05/MF A01.

The diverse facilities, operations and equipment at a major national research and development laboratory require a systematic, analytical approach to operating equipment maintenance. A computer-scheduled preventive maintenance program is described including program development, equipment identification, maintenance and inspection instructions, scheduling, personnel, and equipment history.

14013 (UCRL—83063) **Modeling particulate additive influences and transport at gun barrel walls.** Buckingham, A.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jan 1980. Contract W-7405-ENG-48. 20p. (CONF-800308—1). Dep. NTIS, PC A02/MF A01.

From JANNAF propulsion meeting; Monterey, CA, USA (11 Mar 1980).

Numerical modeling is applied to simulate the influence of particles on erosive transport in a turbulent reactive boundary layer. The model includes effects of additive particles used to suppress wall erosion in turbulent propellant combustion. At its current stage of development the model simulates additive erosion reduction by alteration of erosive boundary layer convection and transport processes. Turbulent particle/gas interactions are computed using random statistical velocity fluctuations. These produce particulate trajectories, distributions and momenta. The interactions include effects of particle size, mass, and rotation as well as two-particle hard sphere collisions. The main purpose of this work is to evaluate the effects of direct coupling between particle-laden boundary layer and an eroding solid surface. Even in the absence of thermal relaxation, the heat transfer rates are found to be substantially reduced when smaller diameter (0.2 μm) particles are introduced as compared to larger diameter particles (5 μm). The apparently substantial influence of water vapor in the combustion products is also examined.

14014 (UCRL—83075) **Unsteady gun-barrel boundary-layer calculations.** Kang, S.W.; Levatin, J.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jan 1980. Contract W-7405-ENG-36. 10p. (CONF-800308—2). Dep. NTIS, PC A02/MF A01.

From JANNAF propulsion meeting; Monterey, CA, USA (11 Mar 1980).

The paper describes current progress in the calculation of nonsteady boundary layers involved in internal flow situations to determine the dominant mechanisms of erosion. A time-dependent description of the viscous (laminar and turbulent) layer is formulated, and numerical solutions are obtained by application of a factored ADI scheme. The conservation equations in the alternate-sweep form are then solved under prescribed (transient and streamwise varying) core-flow conditions. Verification of the method is made by comparing with available previous analyses, with favorable agreement. Calculations of the compressible, turbulent flow cases demonstrate strongly nonsimilar flow characteristics, suggesting that the high heat flux at the wall due to turbulence and the changing core conditions may in time cause severe temperature rise at the wall and may produce environments conducive to melting, ablation and erosion of the surface itself.

14015 (UCRL—83334) **Lawrence Livermore Laboratoy two-stage, light-gas gun.** Mitchell, A.C.; Nellis, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1979. Contract W-7405-ENG-48. 12p. (CONF-7909112—1). Dep. NTIS, PC A02/MF A01.

From 30. Aeroballistic Range Association meeting; Burlington, VT, USA (19 Sep 1979).

The Lawrence Livermore Laboratory two-stage gun was obtained from General Motors Corporation in the early 1970's. The operation and performance of the gun are described. The facility is used primarily for high pressure and high temperature material property studies and can achieve pressures about twice what can be realized with high-explosive planewave systems.

14016 **Method and turbine for extracting kinetic energy from a stream of two-phase fluid.** Elliott, D.G. US Patent 4 141 219. 27 Feb 1979. Filed date 31 Oct 1977. 9p.

An axial flow separator turbine is described which includes a number of nozzles for delivering streams of a two-phase fluid along linear paths. A phase separator which responsively separates the vapor and liquid is characterized by concentrically related annuli supported for rotation within the paths. The separator has endless channels for confining the liquid under the influence of centrifugal forces. A vapor turbine fan extracts kinetic energy from the liquid. Angular momentum of both the liquid phase and the vapor phase of the fluid is converted to torque.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 13628, 14038, 14560

14017 (LA—8111) **4 K to 20 K rotational-cooling magnetic refrigerator capable of 1-mW to >1-W operation.** Barclay, J.A. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

The low-temperature, magnetic entropy of certain single-crystal paramagnetic materials, such as $DyPO_4$, changes dramatically as the crystal rotates in a magnetic field. A new magnetic refrigerator design based on the anisotropic nature of such materials is presented. The key advantages of the rotational-cooling concept are (1) a single, rotary motion is required, (2) magnetic field shaping is not a problem because the entire working material is in a constant field, and (3) the refrigerator can be smaller than comparable magnetic refrigerators because the working material is entirely inside the magnet at all times. The main disadvantage of the rotational-cooling concept is that small-dimension single crystals are required.

14018 (N—79-17165) **Electrical machines with superconducting windings. volume 2: heteropolar dc machines. Final report.** Auinger, H.; Bogner, G.; Czernohous, F.; Fuchs, W.; Hilmer, W. (Siemens A.G., Nuremberg (Germany, F.R.)). Dec 1977. 147p. NTIS, PC A07/MF A01.

Together with the design of a 1.7 MW-dc motor with a heteropolar superconducting set of pole windings (main and commutating poles) and with a normal-conducting armature winding and commutator, the special requirements of construction and manufacture as well as the operating qualities were studied. Half the weight and approximately three times the manufacturing costs characterize this type of dc machine with its other qualities similar to those of a conventional dc machine. Fast and frequent changes of the current are to be avoided because of the losses occuring in the superconducting pole windings.

14019 Demonstration of a helical armature for a superconducting generator. Conley, P.L.; Kirtley, J.L. Jr.; Hagman, W.H.; Ula, A.H.M.S. (MIT, Cambridge, Mass). pp 8p, Paper F 79 716-2 of 1979 IEEE summer power meeting. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From 1979 IEEE summer power meeting; Vancouver, Canada (Jul 1979).

This is a report on the design, construction and testing of an experimental helical armature for a superconducting geneator. Rated at 60 kVA, this armature was built to be operated in conjunction with the rotor of the first experimental superconducting machine built at MIT. It incorporates, in addition to the helical winding form, a high density edge-brazed end turn geometry, molded bar groups, and silicone fluid coolant and insulation impregnant. Tests showed that the thermal performance of the armature was within reasonable limits, magnetic analyses leading to the computation of reactance and voltage geneation were approximately correct. No abnormal cheating was observed. 9 refs.

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 13131

14020 (CONF-791103—69) **Alpha-Gamma Hot-Cell Facility at Argonne National Laboratory East.** Neimark, L.A.; Jackson, W.D.; Donahue, D.A. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 22p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

The Alpha-Gamma Hot-Cell Facility has been in operation at Argonne National Laboratory East (ANL-E) for 15 years. The facility was designed for plutonium research in support of ANL's LMFBR program. The facility consists of a kilocurie, nitrogen-atmosphere alpha-gamma hot cell and supporting laboratories. Modifications to the facility and its equipment have been made over the years as the workload and nature of the work changed. These modifications included inerting the entire hot cell, adding four work stations, modifying in-loading procedures and examination equipment to handle longer test articles, and changing to a new sodium-vapor lighting system. Future upgrading includes the addition of a decontamination and repair facility, use of radio-controlled transfer carts, refurbishment of the zinc bromide windows, and the installation of an Auger microprobe.

SHIPPING CONTAINERS

14021 (MLM—2242(Rev.1)) **Safety Analysis Report for Packaging (SARP) for USA/5790/BLF (DOE-AL) and USA/5791/BLF (DOE-AL).** Roome, L.G.; Watkins, R.A.; Bertram, R.E.; Kreider, H.B. (Mound Facility, Miamisburg, OH (USA)). 25 Jan 1980. Contract EY-76-C-04-0053. 109p. Dep. NTIS, PC A06/MF A01.

This revised Safety Analysis Report for Packaging (SARP) includes discussions of structural integrity, thermal resistance, radiation shielding and radiological safety, nuclear criticality safety, and quality control of shipping containers. Much of the information was previously submitted to AEC/OSD/ALO and the Department of Transportation (DOT) and provided the basis for obtaining special permits DOT-SP-5790 and DOT-SP-5791 as well as the Interim Certificates of Compliance until the original SARP could be prepared and Certificates of Compliance issued by ERDA. This SARP revision incorporates information on certain design changes, the most significant of which relate to the inner container for the type 5790 package. Complete physical and technical descriptions of the packages are presented. Each package consists of a cylindrical steel inner container centered within an insulating steel drum assembly. The contents may be any radioactive materials which satisfy the requirements established in this SARP. A shipment of plutonium-238 in the form of a solid oxide is evaluated in this SARP as an example. The results of the nuclear criticality safety analysis show how much of the fissile isotopes may be shipped as Fissile Class I, II, or III for each container. Design and development considerations, the tests and evaluations required to prove the ability of the containers to withstand normal transportation conditions, and the sequence of four hypothetical accident conditions (free drop, puncture, thermal, and water immersion) are discussed. Tables, graphs, dimensional sketches, photographs, technical references, loading and shipping procedures, Mound Facility experience in using the containers, and copies of the DOE Certificates of Compliance are included. Internal reviews of the original and revised SARP's have been performed in compliance with the requirement of DOEM 5201-Part V.

TRANSPORT AND STORAGE FACILITIES

14022 (NUREG/CR—0619) **Properties of radioactive wastes and waste containers. First topical report.** Becker, W.; Colombo, P.; Francis, A.J. (Brookhaven National Lab., Upton, NY (USA)). Aug 1979. Contract EY-76-C-02-0016. 164p. (BNL-NUREG—50957). Dep. NTIS, PC A08/MF A01.

This topical report summarizes the results of the NRC sponsored program, Properties of Radioactive Wastes and Waste Containers, from its inception through September 1978. The properties of waste forms and packages resulting from the solidification of liquid concentrate and solid wastes generated as by-products of the liquid radioactive waste treatment systems in commercial BWRs and PWRs have been determined. The solidification agents currently employed at power reactors in the United States and (to a lesser extent) agents actively marketed for solidification of these wastes were considered. The waste form and package properties that have been studied in the experimental program include leachability, thermal stability, combustibility, thermal conductivity, mechanical strength, dispersibility, radiation stability, corrosion, and biodegradability. In addition, work has been conducted to determine the effects of various processing parameters on basic waste form criteria. This information is required to assess the safety and environmental impacts of radioactive waste disposal and to support quality control and assurance standards for radioactive waste treatment systems in operating facilities.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 13015

LASERS

REFER ALSO TO CITATION(S) 14573

14023 (AD-A—062921) **Investigation of optimum laser pumping. Interim technical report, 16 November 1977-15 May 1978.** Srivastava, B.N.; Jacob, J.H.; Rokni, M. (Avco-Everett Research Lab., Everett, MA (USA)). Dec 1978. Contract N00014-75-C-0062,. 35p. NTIS, PC A03/MF A01.

An important task of the Optimum Pumping Technology program is the investigation of the feasibility of discharge pumping electronic transition lasers. Such an investigation requires a detailed knowledge of the secondary electron transport properties that may be obtained from a numerical solution of the Boltzmann code. An example of an electronic transition discharge pumped laser is HgCl.

14024 (AD-A—063074) **Magneto-optic materials for biasing ring laser gyros. Interim report no. 1.** Krebs, J.J.; Prinz, G.A. (Naval Research Lab., Washington, DC (USA)). Apr 1978. 40p. NTIS, PC A03/MF A01.

A series of new materials, including magnetic glasses of Fe-Si and Fe-B in varying compositions, permalloys, Fe-overcoated permalloys, and single element standards Fe, Ni, and Co have been fabricated and characterized. These results, as well as an analysis of the application of magneto-optic materials to the laser gyro bias problems, are presented.

14025 (AD-A—069284) **Visible chemical laser development. Final technical report Jan—Dec 78.** Blauer, J.A.; Brandkamp, W.F.; Solomon, W.C. (Bell Aerospace Textron, Buffalo, NY (USA)). May 1979. Contract DASG60-78-C-0030. 37p. NTIS, PC A03/MF A01.

Experimental data are presented relative to attempts to induce laser oscillations in the vicinity of 5578 A in a chemically prepared tin oxide medium. Atomic tin was first prepared by shock-heating mixtures of $SnCl^4$ in argon. The plenum gases were accelerated through a nozzle bank and molecular N^2O was injected into the supersonic flow stream. Medium diagnostics were conducted in a windowed section downstream of the nozzle exit plane. During the course of these studies, it was found that atomic chlorine, a fragament of $SnCl^4$ dissociation, proved very deleteriuos to the retention of SnO (a3 Sigma(+)) excited molecules within the medium. To overcome this difficulty, the tin vapor was prepared by entraining within the oncoming shock wave the products of an exploding tin wire. This permitted over a 100 fold increase in the concentration of excited species. To date, all attempts to induce laser oscillations within the chemically prepared medium have been unsuccessful. Computer modeling of the system indicates that the major reasons for this failure were that the medium temperature was far too high, and that the density of tin vapor must be increased about three fold. Data are presented relative to number density measurements for SnO(a3 Sigma(+)) under a variety of experimental conditions and to the several attempts to induce laser oscillations within the seemingly optimized medium.

14026 (COO—4275-9) **Metal vapor excimer laser. Quarterly progress report, May 1, 1979-July 30, 1979.** Mandl, A.; Klimek, D. (Avco-Everett Research Lab., Inc., Everett, MA (USA)). Oct 1979. Contract ES-77-C-02-4275. 15p. Dep. NTIS, PC A02/MF A01.

The formation efficiency for discharge pumping $HgCd^*$ has been measured as 0.5 indicating near to unity branching of $HgCd^*$ formation. Gain/absorption measurements show what appears to be intrinsic absorption over the $HgCd^*$ emission band.

14027 (LA-UR—80-108) **Short-pulse CO_2-laser damage studies of NaCl and KCl windows.** Newnam, B.E.; Nowak, A.V.; Gill, D.H. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 22p. (CONF-7910101—2). Dep. NTIS, PC A02/MF A01.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (30 Oct 1979).

The damage resistance of bare surfaces and the bulk interior of NaCl and KCl windows was measured with a short-pulse CO_2 laser at 10.6 μm. Parametric studies with 1.7-ns pulses indicated that adsorbed water was probably the limiting agent on surface thresholds in agreement with previous studies at long pulsewidths. Rear-surface thresholds up to 7 J/cm^2 were measured for polished NaCl windows, whereas KCl surfaces damaged at approximately 60% of this level. The breakdown electric-field thresholds of exit surfaces were only 50% of the value of the bulk materials. The pulsewidth dependence of surface damage from 1 to 65 ns, in terms of incident laser fluence, increased as t/sup 1/3/.

14028 (N—79-26384) **Design investigation of solar powered lasers for space applications. Final report.** Taussig, R.; Bruzzone, C.; Quimby, D.; Nelson, L.; Christiansen, W. (Mathematical Sciences Northwest, Inc., Bellevue, WA (USA)). May 1979. Contract NAS3-21134. 184p. NTIS, PC A09/MF A01.

The feasibility of solar powered lasers for continuous operation in space power transmission was investigated. Laser power transmission in space over distances of 10 to 100 thousand kilometers appears possible. A variety of lasers was considered, including solar-powered GDLs and EDLs, and solar-pumped lasers. An indirect solar-pumped laser was investigated which uses a solar-heated black body cavity to pump the lasant. Efficiencies in the range of 10 to 20 percent are projected for these indirect optically pumped lasers.

14029 **Measurements and modeling of gain coefficients for neodymium laser glasses.** Linford, G.J.; Saroyan, R.A.; Trenholme, J.B.; Weber, M.J. (Univ of Calif, Lawrence Livermore Lab). *IEEE J. Quant. Electron.;* **QE-15**: No. 6, 510-523(Jun 1979).

Small-signal gain coefficients are reported for neodymium in silicate, phosphate, fluorophosphate, and fluoroberyllate laser glasses. Measurements were made in a disk amplifier under identical conditions. Using spectroscopic data as the input, amplifier gain is calculated as a fucntion of flashlamp energy, pumping pulse duration, disk thickness, and Nd-doping. The agreement between predicted and measured gains is generally with ;plus or minus;10 percent, consistent with experimental uncertainties in the model and the parameters used. The operating conditions which optimize amplifier performance and efficiency for a given laser glass may be found using spectroscopic data alone. This process can be extended to derive the most cost-effective staging of amplifier chains for fusion lasers. A discussion of the model and examples of calculations are presented.

14030 **Calculating the space-time characteristics of laser radiation with inhomogeneous distribution of pumping energy being taken into account.** Kovalenko, E.S.; Shangina, L.I.; Zamotrinskii, V.A.; Kolchina, G.A. *Zh. Prikl. Spektrosk.;* **24**: No. 4, 602-606(Apr 1976). (In Russian).

A look is taken at the effect of amplification inhomogeneity on the kinetics of generated light and laser radiation parameters with highly inhomogeneous pumping. A calculational technique is presented by means of which it is possible to track development of the field in the laser and to estimate the change in structure of the modes and parameters of the radiation as a function of pumping inhomogeneity with diffraction effects, amplification saturation, resonator sphericity and degree of medium inertia being taken into account. Numerical calculations carried out for a continuous ruby laser showed that the character of the kinetics of light generation depends slightly on the magnitude of amplification inhomogeneity. For all values of inhomogeneity which were investigated the field had the character of beams decaying in amplitude in time with a tendency to transition to a mode of continuous generation. This behavior indicates that for this generator model the pumping inhomogeneity is not the main reason of the beam mode. At the same time the inhomogeneity has a substantial effect on the parameters of the generator modes, when its characteristic size becomes comparable with the size of the spot on the active element. A study was made of the possibilities of using Gaussian beams with a square dependency on the modes being taken into account in similar generators.

14031 **Spectral composition of light generation from solutions of neodymium in the oxyhalides of phosphorous and sulfur.** Kaporskii, L.N.; Kalabushkin, O.I.; Chinyakov, S.V.; Kasatkin, V.P.; Belyaev, V.V.; Sinyuta, S.A. *Zh. Prikl. Spektrosk.;* **24**: No. 4, 618-621(Apr 1976). (In Russian).

Results are presented on a study of the spectral composition of light generation from neodymium ions in inorganic solutions of phosphorous oxychloride $POCl_3$ and thionyl chloride $SOCl_2$. It is shown that depending on the solution composition a displacement in the light wavelength can be brought about within the limits of 4.5 nm at a line width of 0.2 nm. It was found that the neodymium light spectra in the oxychloride solution undergo contraction with an increase in pumping in contrast to glass. An explanation of the experimental facts is advanced.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 13728, 13762, 13787, 13794, 13795, 14016

14032 (ANL—79-103) **Nondestructive evaluation techniques for silicon carbide heat-exchanger tubes. Second annual report, October 1978-September 1979.** Kupperman, D.S.; Yuhas, D.; Deininger, W.; Sciammarella, C. (Argonne National Lab., IL (USA)). Nov 1979. Contract W-31-109-ENG-38. 66p. Dep. NTIS, PC A04/MF A01.

This report discusses the development of ultrasonic testing, acoustic microscopy, dye-enhanced radiography, holographic interferometry, and infrared scanning techniques for flaw detection in silicon carbide (SiC) heat-exchanger tubing. Both preservice and in-service testing requirements are discussed. An ultrasonic boreside probe and an acoustic microscope stage have been designed for continuous monitoring of SiC tubing. Preliminary results with these acoustic systems are presented. In addition, a novel technique for detecting small surface flaws using holographic interferometry is discussed. Fracture mechanics analysis suggests that detection of flaws on the order of 100 μm is necessary to assure good reliability of ceramic heat exchangers. The acoustic and holographic techniques have been shown to be capable of detecting flaws of this size. However, the sensitivity of ultrasonic flaw detection in SiC is affected by the microstructure of the component. The practical considerations involved in the use of these techniques are discussed.

14033 (COO—4649-8) **Research workshop on energy conservation through enhanced heat transfer.** Junkhan, G.H.; Bergles, A.E.; Webb, R.L. (Iowa State Univ. of Science and Technology, Ames (USA). Heat Transfer Lab.). Oct 1979. Contract ET-78-S-02-4649. 134p. Dep. NTIS, PC A07/MF A01.

Seven papers were presented at the meeting. A separate abstract was prepared for each paper. (LCL)

14034 (COO—4649-8, pp 21-25) **Review of augmentation techniques: a synopsis.** Bergles, A.E.; Webb, R.L. Oct 1979.

In Research workshop on energy conservation through enhanced heat transfer.

Methods for augmenting, enhancing, or intensifying the heat transfer performance of heat exchangers are summarized. These methods include passive techniques such as exchanger surface treatments, fluid additives, and tube geometries or fixed inserts for promoting swirl flow. Active heat transfer augmentation techniques include mechanical stirring, vibration of the fluids or surfaces, application of electrostatic fields, gas injection into liquid flow, and suction for vapor removal during boiling. (LCL)

14035 (ISM—253) **Simulation of chemical reaction in a turbulent flow.** Hill, J.C. (Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Chemical Engineering). 1979. Contract W-7405-ENG-82. 28p. (CONF-7903109—1). Dep. NTIS, PC A03/MF A01.

From Chemical engineering research symposium; Ames, IA, USA (8 Mar 1979).

The mass conservation equations for chemical species undergoing convection, diffusion, and irreversible chemical reaction were numerically integrated over time using a numerical simulation of two-dimensional, homogeneous, turbulent velocity fields with assignable statistical properties. Statistical independence hypotheses that had been proposed by O'Brien for single-species reactions and by Toor for two-species reactions were tested by comparing exact statistical quantities during evolution of the concentration fields.

14036 (PB—294658) **Energy report: heat transfer principles. Technical memo (final).** (Albany County Planning Board, NY (USA)). May 1978. Contract HUD-D-11467. 12p. NTIS PC A02/MF A01.

This pamphlet is a primer on the basics of heat transfer and related physical principles with a bibliography of primary sources.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 13891, 14006

14037 (LA-UR—80-172) **Image processing applications in NDE.** Morris, R.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-800207—2). Dep. NTIS, PC A02/MF A01.

From SPIE meeting; North Hollywood, CA, USA (4 Feb 1980).

Nondestructive examination (NDE) can be defined as a technique or collection of techniques that permits one to determine some property of a material or object without damaging the object. There are a large number of such techniques and most of them use visual imaging in one form or another. They vary from holographic interferometry where displacements under stress are measured to the visual inspection of an objects surface to detect cracks after penetrant has been applied. The use of image processing techniques on the images produced by NDE is relatively new and can be divided into three general categories: classical image enhancement; mensuration techniques; and quantitative sensitometry. An example is discussed of how image processing techniques are used to nondestructively and destructively test the product throughout its life cycle. The product that will be followed is the microballoon target used in the laser fusion program. The laser target is a small (50 to 100 μm - dia) glass sphere with typical wall thickness of 0.5 to 6 μm. The sphere may be used as is or may be given a number of coatings of any number of materials. The beads are mass produced by the millions and the first nondestructive test is to separate the obviously bad beads (broken or incomplete) from the good ones. After this has been done, the good beads must be inspected for spherocity and wall thickness uniformity. The microradiography of the glass, uncoated bead is performed on a specially designed low-energy x-ray machine. The beads are mounted in a special jig and placed on a Kodak high resolution plate in a vacuum chamber that contains the x-ray source. The x-ray image is made with an energy less that 2 keV and the resulting images are then inspected at a magnification of 500 to 1000X. Some typical results are presented.

14038 (UCRL—50025-79-3, pp 4-9) **Real-time, ultrasonic inspection system evaluates superconducting cable.** 30 Sep 1979.

In Electronics Engineering Department. Quarterly report No. 3, 1979.

In the course of building the Mirror Fusion Test Facility a real-time, microcomputer-based, ultrasonic inspection system was developed. The system evaluates the quality of superconducting cable before it is used to build the magnets that will contain a fusion reaction. Multichannel data acquisition is accomplished with a high-speed analog-to-digital converter with direct memory access. A real-time data analysis program checks data for flaws and reports any damage to a teletypewriter. The system, written in DEC RT-11/FORTRAN, is designed for stand-alone operation in harsh industrial environments.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 14145, 14149, 14150, 14151

14039 (UCID—18514) **DASLL: user's training and procedures manual.** Magnuson, W.G. Jr.; Willett, G.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1979. Contract W-7405-ENG-48. 56p. Dep. NTIS, PC A04/MF A01.

This manual is a brief description on how to use the DASLL system to lay out printed circuit boards. It covers how to prepare input, how to run DASLL on the OCTOPUS CDC 7600 computer system, and how to make the DASLL system output ready for final inspection. 16 figures.

14040 (UCID—18533) **DASLL (Design Automation system at Lawrence Livermore Laboratory): System reference manual.** Magnuson, W.G. Jr.; Willett, G.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1979. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC E06/MF E06.

DASLL stands for Design Automation System at Lawrence Livermore Laboratory, and is a set of computer programs for the laying out of electronic printed circuit boards. This report complements other documenation and provides information for a programer or DA specialist who wishes to learn more about DASLL, maintain the system, or install it on another computer system. The DASLL system structure is described together with brief descriptions of the data base and internal file structures. Included also on microfiche is a complete program listing with extensive comments.

14041 (UCRL—50025-79-3, pp 1-3) **New type of transient recorder will provide hydrodynamic test data in computer-compatible form.** 30 Sep 1979.

In Electronics Engineering Department. Quarterly report No. 3, 1979.

Charge-coupled devices in a new serial-parallel-serial (SPS) architecture have been produced. These devices are key components for a 1-GHz transient digitizer that can immediately present information in a computer-compatible form.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 13821

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 13033, 13034, 13038, 13039, 13040, 13041, 13514, 13515, 13798

14042 (ANL/EES-TM—69) **Pulse combustion technology for heating applications. Quarterly progress report, July 1-September 30, 1979.** Ahrens, F.W.; Clinch, J.M. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

The primary purpose of this program is to develop design data and procedures for pulse combustion burners. The program will thus contribute to the accelerated industrial development of cost-effective, high-efficiency systems for a variety of heating applications. The major program tasks are designated as: Burner Performance Studies, Burner Noise Studies, and Evaluation and Application. Analytical and experimental data for the period July 1, 1979, through September 30, 1979 for natural gas-fired pulse combustion burners are reported.

14043 (PB—290914) **Design and construction of a fluidized-bed combustion sampling and analytical test rig. Final report, August 1976—April 1978.** Dehne, H. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Aug 1978. Contract EPA-68-02-2170. 141p. NTIS, PC A07/MF A01.

The report describes the design, construction, and installation of a fluidized-bed coal combustion sampling and analytical test rig in the High Bay Area (Wing G) of EPA's Industrial Environmental Research Laboratory (IERL), Research Triangle Park, North Carolina. The rig, to be used by IERL to investigate the emission characteristics of fluidized-bed combustors, was designed for maximum flexibility, accuracy, and utility. System operating ranges are: coal feedrate--10 to 50 kg/hr; sorbent feedrate--zero to 25 kg/hr; excess air--10 to 300%; bed temperature--750 to 1100C; and fluidizing velocity--1 to 5 mps. The program included four phases: conceptual design; final design; purchase, fabrication, and installation; and checkout, testing, and documentation. After installation, an acceptance test demonstrated that the system had been completed in accordance with the approved design, and that all equipment was properly installed and corrected to serve its intended purpose.

14044 (PB—292880) **Application of combustion modifications to industrial combustion equipment (data supplement b). Report, for January 1976—January 1978.** Fisher, K.T.; Buening, H.J.; Carter, W.A.; Engel, P.K.; Hunter, S.C. (KVB, Inc., Tustin, CA (USA)). Feb 1979. Contract EPA-68-02-2144. 446p. NTIS, PC A19/MF A01.

The supplement provides raw data from a study of the effects of combustion modifications on air pollutant emissions from a variety of industrial combustion equipment. Tested were 22 units, including refinery process heaters; clay and cement kilns; steel and aluminum furnaces; boilers burning black liquor, woodbark, and CO gas; internal combustion engines; and gas turbine combined cycles. Process variables, fuel types, excess air reduction, burner adjustments, and staged combustion were evaluated primarily for their effect on NO/sub x/ emissions. Emissions of NO/sub x/, SO/sub x/ CO, and HC were measured on all units. Emissions of particulate mass and size, trace species, and organics were measured on selected units. This data supplement is intended for researchers who wish to perform their own detailed calculations.

14045 (PB—293037) **Regenerable sorbents for fluidized bed combustion. Quarterly progress report, no. 5, 1 January 1977—31 March 1977.** Ruth, L.A.; Varga, G.M. Jr. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.). 1 Apr 1977. 43p. NTIS, PC A03/MF A01.

Progress made in a search for superior sorbents which can be used to remove sulfur compounds from burning coal is presented. This report describes the successful forming of strong, reactive pellitized sorbents from barium titanate and calcium aluminate cement (CAC). Also reported is information concerning barium titanate reactivity, the thermodynamics of calcium titanate, calcium oxide in alpha-aluminum oxate pellets, attrition tests of sorbents, projected fluidized bed combustion (FBC), sorbent demand, and preparation cost of new sorbents. In a continuing investigation of titanate reactivity, BET surface area, porosimetry and optional microscope techniques are used. Calculations show that much higher sulfur dioxide levels can be reproduced from sulfated calcium titanate than from calcium sulfate during regeneration. In CAC pellet preparation, an increased use of water produces a weaker but more reactive cement. Barium and calcium containing materials are shown to be the most effective of five compounds tested for sulfur dioxide

absorption. Results of attrition testing indicate that sulfation increases resistance. The report includes a cost summary, a work progress chart, and future plans.

14046 (PB—293038) **Regenerable sorbents for fluidized bed combustion. Quarterly progress report, no. 6, 1 April 1977—30 June 1977.** Ruth, L.A.; Varga, G.M. Jr. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.). Jul 1977. 41p. NTIS, PC A03/MF A01.

Barium and calcium titanate and calcium aluminum cements are investigated in a search for superior regenerable sorbents which can be used to remove sulfur compounds from burning coal. This report describes progress in the preparation and thermogravimetric analysis of pellets made of these compounds, attrition testing, and the preparation of fluidized bed combustion (FBC), equipment for these synthetic sorbents. The unique ability of barium titanate pellets to maintain and increase their activity after repeated cycles of sulfonation and regeneration is demonstrated. Based on toxicology studies, it is concluded that barium titanate should not be precluded from consideration as an FBC sorbent. Calcium titanate is also shown to retain activity after cycling, but reacts more slowly with sulfur dioxide. Preparation of calcium aluminate cement (CAC) pellets by a dry pressing technique produces pellets more attrition-resistant than limestone. The activity of CAC increases by adding carbon black and burning out the carbon to produce pores. A work progress chart, cost summary graph, and future plans are included in the report.

14047 (PB—293039) **Regenerable sorbents for fluidized bed combustion. Quarterly progress report, no. 7, 1 July 1977—30 September 1977.** Ruth, L.A.; Varga, G.M. Jr. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Lab.). 1 Nov 1977. 33p. NTIS, PC A03/MF A01.

Progress is reported in a search for superior sorbents which can be used to remove sulfur compounds from burning coal. Efforts concentrate on improving both the utilization (fraction converted to sulfate), activity, and attrition resistance of calcium aluminate cement (CAC). Utilization by CAC pellets prepared by extrusion and pressing and treated with carbon black or fly ash is significantly greater than untreated pellets. In attrition testing, CAC pellets prepared with fly ash and carbon black show greater resistance in the pressed form than in the extruded form. Tests on shape differences indicate that spherical pellets have a lower attrition rate than cylindrical pellets. No significant loss of activity or obvious physical decreptation is observed when a pellet of extruded CAC is cycled 25 times. The addition of water vapor to the gas mixture for sulfating sorbents causes Capacitor Grade barium titanate to maintain activity at a high level. Included in the report are a work progress chart, a cost summary, and future plans.

14048 Increasing the carbon-burnup efficiency in fluidized-bed combustors. Sobottka, S.E. (Morgantown Energy Research Center, WV). pp 79-84 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

The carbon-burnup efficiency of fluidized-bed combustors typically ranges from about 85 to 95%. Most of the unburned carbon is contained in particulates and elutriated from the combustor. Current practice is to separate the particulates from the gases in a cyclone and then to recycle the dust back to the combustor or to feed it into a special carbon-burnup cell. A scheme was devised for recycling the dust within the primary combustor itself, without the use of external devices, by the use of baffles and vanes in the freeboard. Unburned solid carbon was reduced by 65% in a 15-cm-dia model.

UNDERGROUND ENGINEERING

14049 (UCRL—52845) **Determination of the pipe stemming load.** Cowin, S.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Oct 1979. Contract W-7405-ENG-48. 32p. Dep. NTIS, PC A03/MF A01.

A mechanical model for the emplacement pipe system is developed. The model is then employed to determine the force applied to the surface collar of the emplacement pipe, the pipe-stemming load, and the stress along the emplacement pipe as a function of stemming height. These results are presented as integrals and a method for their numerical integration is given.

MARINE ENGINEERING

REFER ALSO TO CITATION(S) 13338

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 12993, 14173

14050 (PB—290898) **Trw charged droplet scrubber corrosion studies. Final report, August 1977-October 1978.** Whitson, F.A. (TRW Systems Group, Redondo Beach, CA (USA)). Jan 1979. Contract EPA-68-02-2613. 163p. NTIS, PC A08/MF A01.

The report gives results of corrosion studies to provide definitive data concerning the corrosive nature of coke-oven waste-heat flue gas and its effects on wet electrostatic precipitators, and specifically on TRW's Charged Droplet Scrubber (CDS). The study characterized the chemical composition of the waste heat flue gases; related these data to corrosion and to the effects on the electrostatic scrubbing mechanism; evaluated materials compatibility with the coking process waste heat environment; and identified candidate agents which may be introduced into the waste heat gas stream to minimize the corrosive effects. It was determined that, with several equipment and operating modifications, projected life of the CDS casing and internals is 5 to 10 years, and life expectancy of the electrode nozzles is 1 to 2 years.

14051 (PB—292687) **Alternatives for high-temperature/high-pressure particulate control. Final report, October 1977—October 1978.** Parker, R.; Calvert, S. (Air Pollution Technology, Inc., San Diego, CA (USA)). Jan 1979. Contract EPA-68-02-2190. 137p. NTIS, PC A07/MF A01.

The report gives the status of the most promising high-temperature/high-pressure (HTP) particulate control devices being developed. Data are presented and anticipated performance and development problems are discussed. HTP particulate control offers efficiency and potential economic advantages over cold gas cleanup in pressurized fluidized-bed combustion (PFBC) and low-Btu coal gasification (LBCG) combined-cycle power generation systems. However, considerably more development will be necessary in order to demonstrate the technical and economic feasibility of HTP gas cleanup commercially. The alternative of recuperative heat exchange coupled with low-temperature/high-pressure particulate control is reviewed with regard to power system efficiencies or PFBC and LBCG combined-cycle processes. Successful hot gas cleanup has clear efficiency advantages (1-7%) over cold gas cleanup. The economics of hot gas cleanup, however, are very speculative at the current state of development.

14052 (PB—294716) **Apitron electrostatically augmented fabric filter evaluation. Final report, November 1977-October 1978.** Felix, L.G.; McCain, J.D. (Southern Research Inst., Birmingham, AL (USA)). Feb 1979. Contract EPA-68-02-2181. 118p. NTIS PC A06/MF A01.

The report gives results of fractional and overall mass efficiency tests of two Apitron electrostatically augmented fabric filter dust collectors. The tests were performed on a mobile pilot-scale system collecting flyash produced by a pulverized-coal-fired industrial boiler and on a full-scale pilot plant collecting redispersed silica dust. Total particulate concentrations were determined at the inlet and outlet of both devices. Inlet and outlet emission rates, as a function of particle size, were determined from about 0.5 to 8 micrometers on a mass basis using cascade impactors, and from about 0.01 to 1.0 micrometers using electrical mobility and optical techniques. Total mass efficiency for the mobile system was 99.90-99.94%; fractional efficiencies for the 0.2-1 micrometer particle size range were 99.85-99.94%. Total mass efficiency for the full-scale pilot system was 99.995-99.9994%; fractional efficiencies in the 0.2-1 micrometer size range were 99.90-99.999%.

14053 (PB—294938) **Primary aluminum: draft guidelines for control of fluoride emissions from existing primary aluminum plants.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). 14 Feb 1979. 345p. NTIS PC A15/MF A01.

This document serves as a text to State agencies in planning for control of fluoride emissions from existing primary aluminum plants. Achievable fluoride capture and removal efficiencies are given for new retrofit hooding and for primary and secondary removal devices, respectively. Methods for deriving capital and annualized costs are illustrated by a few examples. Costs and fluoride emission reductions achieved by actual retrofits are given for ten plants, and the construction scope of work is described in detail for three of these plants. The guidelines are presented as recommended control technologies that will achieve certain average control efficiencies when applied as new retrofits to existing plants.

14054 (PB—297198) **Mobile bed flux force/condensation scrubbers. Final report Nov 75-Dec 78.** Yung, S.C.; Chmielewski, R.; Calvert, S. (Air Pollution Technology, Inc., San Diego, CA (USA)). Feb 1979. Contract EPA-68-02-2124. 262p. NTIS, PC A12/MF A01.

The report gives results of an experimental determination of fine particle collection in mobile bed scrubbers. Particle collection

efficiency increased greatly as the gas-phase pressure drop increased. With no water vapor condensation, the performance capability of a mobile bed scrubber is less than that of a gas-atomized spray scrubber with the same pressure drop. Compared to packed bed and sieve plate scrubbers, the mobile bed scrubber has better efficiency when the pressure drop is above 20 cm W.C. Limestone in the scrubber liquid has no effect on particle collection. When the mobile bed scrubber was used as a flux force/condensation (FF/C) scrubber, it had better performance characteristics than sieve plate and spray scrubbers with condensation. However, its capability is inferior to a FF/C system consisting of a condenser and venturi scrubber. Design equations reported in the literature are inadequate to predict the collection efficiency and pressure drop of the mobile bed scrubber. The study developed new correlations to predict particle collection and pressure drop.

14055 (PB—297495) **Epa industrial boiler FGD survey: first quarter 1979. Final report Jan-Mar 79.** Tuttle, J.; Patkar, A.; Kothari, S.; Osterhout, D.; Heffling, M. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Apr 1979. Contract EPA-68-02-2603. 239p. NTIS, PC A11/MF A01.

The report gives detailed technical information concerning application of flue gas desulfurization (FGD) systems to industrial boilers. Design and operation data is presented for 164 FGD control systems (125 of them operational), designed to control SO^2 emissions from 304 industrial boilers at 58 plants. With a 1978 capacity of 8.8 million scfm, an average of more than seven new FGD systems have been put on line each year since 1972. Information in the report was obtained by a survey of plant personnel, control system vendors, regulatory agencies, and consulting engineering firms. The data is given in two types of tables: one gives summary information; the other, detailed information. Summary tables present information as a function of control process, control system vendor, disposal technique, operational status, startup date, and flue gas capacity. Detailed information includes: control system design, economics, operating experience, problems and solutions, waste disposal techniques, and maintenance practices.

14056 (PB—297500) **Test of fabric filtration materials. Final report Jun 73—Dec 78.** Koscianowski, J.R.; Koscianowska, L.; Szablewicz, M. (Institute of Industry of Cement Building Materials (Poland)). Mar 1979. 268p. NTIS, PC A12/MF A01.

The report describes pilot scale and laboratory tests of U.S. and Polish woven baghouse fabrics. Cotton, polyester, aramid, and glass fabrics were tested using cement, flyash, coal, and talc dusts at loadings of about 10 g/cu m, filtration velocities of 60 and 80 cu m/sq m, and ambient temperature and humidity. General conclusions reached were: (1) air permeability is a poor predictor of fabric performance, (2) fabric construction parameters do not correlate well with the resistance coefficient for fabrics Kl, (3) a critical value of pressure drop exists above which fissures are formed in the dust cake, (4) there is a maximum in the efficiency versus air-to-cloth-ratio curve which is related to fissure formation, and (5) cleaning properties of the fabric depend primarily on its chemical composition, the dust being filtered, and the superficial structure of the dust cake and fabric (they do not depend on air-to-cloth ratio).

14057 (PB—297567) **Extended tests of saffil alumina filter media. Final report Feb 78—Feb 79.** Shackleton, M.A. (Acurex Corp., Mountain View, CA (USA)). May 1979. Contract EPA-68-02-2611. 30p. NTIS, PC A03/MF A01.

The report gives results of research aimed at developing filter media performance data under simulated pressurized fluidized-bed combustion conditions for one ceramic filter media candidate. A low-solidity fiber bed, using Saffil alumina ceramic filters was selected. Dust feeding was tested at a nominal 800 C and 10 atm pressure, using reentrained fly ash which had been collected at the EPA/Exxon Miniplant. Tests were performed at three filter media face velocities: 2.5, 4.8, and 9.0 cm/sec. Each test was 200 hours long. Pressure drop and collection efficiency were determined as functions of time and filter face velocity. Off-line cleaning by reverse pulse was effective in maintaining low pressure drop (<1.25 kPa) after a cleaning cycle. Collection efficiency was high (>99.9 percent) and was maintained over the 200 hour test. Collection efficiency was also substantially independent of face velocity over the range tested. Outlet concentration was less than the most stringent requirements proposed for turbine applications (generally <1 mg/cu Nm). Outlet concentration showed a trend toward lower values at higher filtration velocity. Mechanical durability was indicated in that none of the test filters appeared to have been damaged by the 200-hour tests with cleaning at 10-minute intervals.

14058 (PB—297581) **Studies of dust cake formation and structure in fabric filtration: second year. Report for Dec 77—Dec 78.** Miller, B.; Lamb, G.; Costanza, P.; Harriott, G.; Dunbar, J. (Textile Research Inst., Princeton, NJ (USA)). Apr 1979. 48p. NTIS, PC A03/MF A01.

The report describes experiments to improve fabric filter efficiency and pressure drop by use of electric fields near the filter surface. Modified fiber geometries and fabric construction are also investigated. Tests with patch filters showed pressure drops reduced to about 13 mm H_2O from about 36 mm H_2O upon the application of a 6 kV/cm electric field. Total fractional particle penetration was reduced to about 0.001 from 0.170 under the influence of the same field. The electric field was more effective when applied to filters having loose fibers at the surface. Deeply lobed fibers produced filters with higher efficiency, lower pressure drop, and better cleanability than filters made from round fibers. The effects were attributed to induced localized fields at the lobed surfaces. The fields were produced from collection of naturally charged particles. Fabric structure that promotes particle collection near the upstream surface of the filter gave the best performance.

POWER CYCLES

STIRLING

REFER ALSO TO CITATION(S) 13784

14059 **Stirling-cycle prime movers.** Chicago, IL; Institute of Gas Technology (1979). 190p. (CONF-7806176—). $25.00.

From Seminar on stirling-cycle prime movers; Rosemont, IL, USA (14 Jun 1978).

Separate abstracts have been prepared for individual papers. (TFD)

14060 **Role of Stirling engines in power systems.** Neal, J. (Dept. of Energy, Washington, DC). pp 21-28 of Stirling-cycle prime movers. Chicago, IL; Institute of Gas Technology (1979).

From Seminar on stirling-cycle prime movers; Rosemont, IL, USA (14 Jun 1978).

The paper describes DOE programs for developing the Stirling engine for application in stationary power systems. (TFD)

OTHER

14061 (N—79-22626) **Effect of steam addition on cycle performance of simple and recuperated gas turbines.** Boyle, R.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1979. 52p. NTIS PC A04/MF A01.

Results are presented for the cycle efficiency and specific power of simple and recuperated gas turbine cycles in which steam is generated and used to increase turbine flow. Calculations showed significant improvements in cycle efficiency and specific power by adding steam. The calculations were made using component efficiencies and loss assumptions typical of stationary powerplants. These results are presented for a range of operating temperatures and pressures. Relative heat exchanger size and the water use rate are also examined.

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 14476, 14569, 14576

14062 (ANL—79-40, pp 3-21) **Superconducting linac.** Benaroya, R.; Bollinger, L.M.; Shepard, K.W.; Wangler, T.P.; Aron, J.; Clifft, B.E.; Jaffey, A.H.; Johnson, K.W.; Markovich, P.; Nixon, J.M. (Argonne National Lab., IL). 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The Superconducting Linac Project has two main components, both of which are developmental in nature. One is the specific task of designing, building, and testing a small superconducting linac to serve as an energy booster for heavy ions from the present FN tandem electrostatic accelerator. The second, more general, part consists of investigations of various aspects of superconducting rf technology. Although most of these investigations are now aimed at the immediate needs of the booster, many of them are of fairly general interest for accelerator technology. (RWR)

14063 (ANL—79-40, pp 97-98) **Upgrading of the tandem.** Yntema, J.L.; Billquist, P.J.; Munson, F.H. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The program of the tandem-linac accelerator system is summarized under the following headings: operating experience for the tandem, operation of the superconducting linac, upgrading of the tandem (ion sources, vacuum systems, terminal box, stripping foils, beam bunching), installation of the booster, planned accelerator

system improvements, experimental facilities development at the super conducting-linac booster (new beam line, layout and installation of the 0° beam line in the new experiment area, beam optics calculations, 65-in. scattering chamber, split-pole spectrograph, sum/multiplicity detector, nuclear target making and development), and university use of the tandem accelerator. (RWR)

14064 (ANL—79-40, pp 109-112) **Operational experience of the dynamitron.** Mooring, F.P.; Gemmell, D.S.; Elwyn, A.J.; Amrein, R.L.; Ruthenberg, A.E. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

Operational experiences with and university use of the ANL dynamitron are recounted. (RWR)

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 14094, 14568

14065 (BNL—27091) **Some remarks on plasma instabilities in electron and positron colliding beams.** Pellegrini, C.; Tigner, M. (Brookhaven National Lab., Upton, NY (USA); Cornell Univ., Ithaca, NY (USA)). 1979. Contract EY-76-C-02-0016. 3p. (CONF-7910125—1). Dep. NTIS, PC A02/MF A01.

From 2. ICFA workshop on possibilities and limitations of accelerators and detectors; Les Diablerets, Switzerland (4 Oct 1979).

The limitations on the intensity of colliding beams due to the development of plasma instabilities during the collision time are examined for a storage ring and a colliding linacs configuration. It is found that this effect can limit the luminosity for colliding linacs but not for storage rings.

14066 (BNL—27123) **Limitations on anti p-p luminosity with direct injection and stacking of antiprotons.** Courant, E.D.; Teng, L.C. (Brookhaven National Lab., Upton, NY (USA); Fermi National Accelerator Lab., Batavia, IL (USA)). 1979. Contract EY-76-C-02-0016. 6p. (CONF-7910125—2). Dep. NTIS, PC A02/MF A01.

From 2. ICFA workshop on possibilities and limitations of accelerators and detectors; Les Diablerets, Switzerland (4 Oct 1979).

If protons of very high energy impinge on a target, a large part of the resulting antiprotons are sufficiently collimated to be injectible into a stacking and accelerating ring. They can then be stacked and injected into the main proton accelerator so as to produce anti p-p collisions without low energy antiproton cooling. A scheme is presented for the VBA, where 20 TeV protons produce 9 x 10^{-4} antiprotons per proton at 100 GeV, which are then stacked, accelerated to 1 TeV, and injected into the main ring. With 16 proton pulses of 10^{13} protons, one obtains a luminosity of the order of 10^{33} cm^{-2} sec^{-1} with a beam-beam tune shift of 10^{-3} per interaction region. The beams are bunched into 1000 bunches; the orbits are separated by means of relatively modest electostatic electrodes.

14067 **Stability of intense transported beams.** Laslett, L.J.; Smith, L. (Univ of Calif, Lawrence Berkeley Lab). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3080-3082(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

An investigation was conducted of the stability of the K-V distribution in transport by a periodic quadrupole system, a generalization of Gluckstern's analysis for a continuous solenoid. The results are presented and compared with simulation computations for a particular case; the results provide a prediction of maximum transportable current without degradation of emittance due to instability. 4 refs.

14068 **Transport calculations for very high current beams.** Penner, S.; Galejs, A. (NBS, Washington, DC). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3086-3089(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A computer program has been developed to calculate the effect of the transverse space charge forces on a particle beam. The method is to divide the beam into a large number, M, of "beamlets," and compute the force on each beamlet by summing over the forces due to all the others. M is approximately greater than 1000 is needed to make spurious collisional effects negligible. To the space charge forces, the forces due to the physical components of the system such as quadrupoles, solenoids or accelerating gaps are added. Using this program the authors have verified the prediction that at high current, certain perturbations of the K-V distributions are unstable. 9 refs.

14069 **Space charge limited transport and bunching of non k-V beams.** Haber, I. (Nav Res Lab, Washington, DC). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3090-3091(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The possibility of using a beam of energetic heavy ions to ignite a thermonuclear pellet, has increased interest in the transport and focusing of high current low emittance beams. A series of computer simulations has been performed to examine these space charge driven instabilities more generally by using a particle-in-cell model to follow the full nonlinear behavior of non K-V systems. The behavior of the emittance growth during these simulations reinforces previous evidence that the current which can be stably transported is limited. But the rate at which the beam relaxes to this limit depends on the detailed form of the distribution function. 13 refs.

14070 **Time-resolved beam energy measurements at LAMPF.** Clark, D.A.; Bryant, H.C.; Frost, C.A.; Donahue, J.B.; Hamm, M.E.; Wamm, R.W.; Hudgings, D.W.; McNaughton, M.W.; Pratt, J.C.; Yates-Williams, M.A. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3291-3293(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A narrow atomic photodetachment resonance is used to measure the LAMPF beam energy. Energy and time resolution are adequate to permit the use of this method in studying transient changes in accelerated beam energy. 4 refs.

14071 **Electron beam diagnostics in the Fermilab electron cooling experiment.** Kells, W.; McIntyre, P.M. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3300-3301(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Successful electron cooling of antiproton beams requires a precisely aligned and high quality electron beam. Mean e;sup -; momentum and energy are to be held within 0.25 mrad and ;one-half;eV respectively. In addition the e;sup -; "temperature" about this mean (rest frame velocity spread) should be held to ;less than equivalent to;;one-half; eV. The diagnostics required to align the beam in angle and energy are rather straightforward. The temperature measuring diagnostics are more exotic. 4 refs.

14072 **Proton beam diagnostics in the Fermilab electron cooling experiment.** Cline, D.B.; Curtis, C.D.; Gray, E.R.; Jankowski, K.; Johnson, D.E.; Kells, W.; Mills, F.E.; Shea, M.F. (Univ of Wis, Madison). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3302-3303(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The goals of the Cooling Ring experiment are to demonstrate electron cooling in a new range of electron beam parameters and to demonstrate the accumulation of small groups of particles by electron cooling. Requirements of radiation physics on the lightly shielded ring have led to single pulse injection intensities of about 10;sup 7; protons. Proper interpretations of electron cooling experiments require a dynamic measurement of beam profile. Correction of closed orbit errors is required to utilize the full aperture of the system. These considerations have led to the present and planned diagnostic systems. 3 refs.

14073 **High energy electron cooling to improve the luminosity and lifetime in colliding beam machines.** Cline, D.; Garren, A.; Herr, H.; Mills, F.E.; Rubbia, C.; Ruggiero, A.; Young, D. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3472-3475(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Electron cooling can be applied to improve the performance of high energy colliding beams of hadrons and e;sup -;p storage rings. Normal beam excitations such as multiple scattering, resonance growth, or beam-beam interaction can be controlled, leading to longer beam lifetimes, and in some situations to higher luminosities and larger tolerable tune shifts. The elctrons, in a small storage ring, are cooled by radiation and heated by the hadron beam. An equilibrium is reached in which the hadron beam is cooled. The electron beam requires strong cooling by "wigglers". A description is given of a simple cooling experiment for the Fermilab synchrotron. Reasonable cooling times for the antiproton beam require a peak electron current of several amperes, an emittance of about 1*10;sup -8; mm mrad and a momentum spread of about 1*10;sup -3; of the electron beam. The resulting high current density causes instability in the electron machine by electron-electron scattering in the bunches. 6 refs.

14074 **Second-order magnetic optical achromat.** Brown, K.L. (Stanford Univ, Calif). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3490-3492(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A design procedure is given for the elimination of all of the second-order transverse geometric and chromatic aberrations in a

particular class of static-magnetic transport systems for charged-particle beams. 7 refs.

14075 Stable particle motion in a linear accelerator with solenoid focusing. Waddlinger, E.A. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3511-3513(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The stability relations are derived for a linear ion accelerator with solenoidal focusing for the discrete case with solenoids in the drift tubes and for the continuous case with the accelerator contained in one continuous solenoid. The first order transport matrix for the solenoid is given. The author then calculates the transport matrix for one cell and derives the stability relation for the discrete solenoid. An examination is made of the case of the continuous solenoid and it is shown that it is a special case of discrete focusing. 3 refs.

14076 Improved chromaticity control for 100 GeV storage at Fermilab. Ecklund, S.; Gerig, R.; Maclachlan, J.; Pruss, S. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3547-3548(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The current capability of the horizontal sextupole magnets in the main ring has recently been doubled. This allows the chromaticity to be adjusted to near zero at 100 GeV. Effects upon beam lifetime are discussed. 4 refs.

14077 Deceleration of antiprotons in the Fermilab booster. Hojvat, C.; Heisner, K.G.; Ohnuma, S.; Ruggiero, A.G. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3586-3588(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Deceleration has been studied in longitudinal phase space by numerical simulation of the phase motion. Longitudinal acceptances as a function of the antiproton injection momentum, the transition energy and the ramp of the magnetic field are presented. Preliminary deceleration experiments with protons are discussed. 4 refs.

14078 Azimuthal redistribution of beam in the Fermilab main ring. Griffin, J.E.; Mills, F.E. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3589-3591(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A technique is described by which the proton beam in the Fermilab accelerator can be relocated from its original uniform distribution into a much smaller azimuthal region. This allows fast extraction of the entire beam in such a way as to allow single turn injection into a much smaller ring. The technique is applicable to generation, capture, and subsequent cooling of antiprotons. Experimental results are presented. 2 refs.

14079 Calculations pertaining to the design of a prebuncher for a 150-MeV electron linear accelerator. 2. Radial motion. Alsmiller, R.G. Jr.; Alsmiller, F.S.; Barish, J. (Oak Ridge Natl Lab, Tenn). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3695-3697(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A very approximate perturbation model is used to determine the extent to which the prebuncher performance determined previously is modified by radial electron motion. It is found that if a longitudinal magnetic field of 1 kG is applied in the region containing the voltage gaps and if a sufficiently strong longitudinal magnetic field d(approximately 3 kG) is applied in the drift space the prebuncher performance determined here is essentially the same as that shown in a previous work. 3 refs.

AUXILIARIES AND COMPONENTS

ION SOURCES

14080 Tests on the intense neutron source (INS) prototype. Armstrong, D.D.; Emigh, C.R.; Hyde, J.C.; Meyer, E.A.; Schneider, J.D. (Los Alamos Sci Lab, NM). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3055-3057(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A prototype of the INS accelerator system was constructed to produce an intense dc beam of protons at energies up to 200 keV. Using a Pierce geometry accelerating system, a 250-mA dc beam of hydrogen ions was extracted at an energy of 125 keV from an annular duoplasmatron. Of this beam, 100 mA of H;sup +; ions were transported into a 1-cm-diam supersonic jet target, with backstreaming gas minimized by differential pumping. Both the jet target and the differential pumping system functioned satisfactorily. No substantial increase in backstreaming of the nitrogen jet gas occurred for a beam power equivalent to 150 kW of tritons onto deuterium. 2 refs.

14081 100-mA low-emittance ion source for ion-beam fusion. Vahrenkamp, R.P.; Seliger, R.L. (Hughes Res Lab, Malibu, Calif). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3101-3103(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A Penning-type ion source is described that meets the following requirements for ion-beam fusion: Pulsed capability, high currents of heavy ions, and low emittance. The source is a scaled version of a lower-current ion source that produces 2 mA of singly charged xenon ions with a normalized emittance of 0.0015 mrad-cm. The scaled source, which utilizes permanent magnets and a filament cathode, was tested with both multiple- and single-aperture extraction. In the former case, pulsed xenon-ion currents of 100 mA at 2.5 keV were achieved at a current density of 15 mA/cm;sup 2;; in the latter case, 30 mA at 4.5 mA/cm;sup 2; was extracted at 100 keV. The 30-mA case represents the first-gap conditions of a high gradient 1.5 MeV dc preaccelerator. In all tests, the pulse length was ;similar;1 msec with a repetition rate of 0.2 to 1.0 Hz.

14082 Universal negative or positive ion source. Alton, G.D. (Oak Ridge Natl Lab, Tenn). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3708-3712(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

This report describes a multipurpose negative or positive ion source which can be used in a variety of low energy or high energy research applications. Conversion from negative/positive modes of operation can be accomplished by simply reversing the polarities of pertinent extraction and beam transport power supplies. Preliminary results obtained from recent evaluative studies along with design details and negative and positive yields observed to data are given. Thus far, the source has demonstrated ;mu;A intensity capabilities for several negative and positive ion species including C;sup -;, Cu;sup -;, Au;sup -;, N;sup +;, N;sub 2;;sup +;, P;sup +;, A;sup +;, and Cs;sup +;. 17 refs.

14083 Fluorocarbon stripping of low beta heavy ions. Alonso, J.R.; Leemann, B.T. (Univ of Calif, Lawrence Berkeley Lab). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3718-3720(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Equilibrium charge state distributions were measured for Kr, Xe, Ho and Pb ions at energies from 25 to 160 keV/amu passing through a high molecular weight fluorocarbon vapor, as well as air and carbon foil strippers. Measured charge state distributions are given which show that the fluorocarbon distributions are intermediate between those of air and foil strippers, becoming closer to foil values as velocity is decreased. At all energies substantial asymmetry in the fluorocarbon distributions towards higher charge states were observed. These favorable distributions, coupled with very high beam handling capability, low maintenance and indefinite lifetime clearly indicate the value of fluorocarbon stripping for many accelerator applications. 5 refs.

INJECTION AND EXTRACTION SYSTEMS

14084 Multiturn charge exchange injection system for the Fermilab booster accelerator. Hojvat, C.; Ankenbrandt, C.; Brown, B.; Cosgrove, D.; Garvey, J.; Johnson, R.P.; Joy, M.; Lackey, J.; Meisner, K.; Schmitz, T.; Teng, L.; Webber, R.C. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3149-3151(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Since March 1978 the Fermilab Booster has operated with H;sup -; multiturn charge exchange injection. A record number of protons per Booster cycle has been injected and accelerated to 8 GeV. The details of the injection system are discussed as well as the Booster performance and the reliability of the method. 11 refs.

14085 Design of an additional extraction/injection area for the Fermilab booster. Brown, B.C.; Ankenbrandt, C.M.; Cosgrove, D.; Garvey, J.D.; Johnson, R.P.; Meisner, K. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3173-3175(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

In order to allow for high energy colliding beams with Fermilab accelerators it is necessary to provide beams which circulate counterclockwise in the Main Ring tunnel. A new extraction area has been designed and a tunnel to the main ring constructed. This transfer line to the main ring uses only small bends to accept (normal) counterclockwise circulating booster beam and create counterclockwise main ring beam. 5 refs.

EXPERIMENTAL FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 14080, 14084

14086 (ANL/ES—82) **Particle-accelerator decommissioning.** Opelka, J.H.; Mundis, R.L.; Marmer, G.J.; Peterson, J.M.; Siskind, B.; Kikta, M.J. (Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109-ENG-38. 129p. Dep. NTIS, PC A07/MF A01.

Generic considerations involved in decommissioning particle accelerators are examined. There are presently several hundred accelerators operating in the United States that can produce material containing nonnegligible residual radioactivity. Residual radioactivity after final shutdown is generally short-lived induced activity and is localized in hot spots around the beam line. The decommissioning options addressed are mothballing, entombment, dismantlement with interim storage, and dismantlement with disposal. The recycle of components or entire accelerators following dismantlement is a definite possibility and has occurred in the past. Accelerator components can be recycled either immediately at accelerator shutdown or following a period of storage, depending on the nature of induced activation. Considerations of cost, radioactive waste, and radiological health are presented for four prototypic accelerators. Prototypes considered range from small accelerators having minimal amounts of radioactive mmaterial to a very large accelerator having massive components containing nonnegligible amounts of induced activation. Archival information on past decommissionings is presented, and recommendations concerning regulations and accelerator design that will aid in the decommissioning of an accelerator are given.

14087 (BNL—26936) **X-ray monochromator geometry for focusing synchrotron radiation above 10 keV.** Sparks, C.J. Jr.; Borie, B.S.; Hastings, J.B. (Oak Ridge National Lab., TN (USA); Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 18p. (CONF-790651—8). Dep. NTIS, PC A02/MF A01.

From National conference on synchrotron radiation instrumentation; Gaithersburg, MD, USA (4 Jun 1979).

The relative merits of crystals versus mirrors for focusing synchrotron radiation at energies above 10 keV are explored. As mirrors have critical angles of reflection typically 1/20 of the Bragg scattering angles for crystals, large mirror surface areas are required. Sagittal focusing is weak for mirrors and limits the amount of radiation intercepted. Crystals bent to a simple cylindrical curvature are shown to accept large divergences of radiation for sagittal focusing. At a magnification near 1/3, the cylindrically curved crystals are shown to make the proper Bragg angle for energies above 5 keV and for divergences larger than 10 mrad and to produce x-ray beams which are approximately focused.

14088 (BNL—27032) **Conceptual design of a dipole detector for ISABELLE.** Palmer, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 26p. (CONF-7910103—2). Dep. NTIS, PC A03/MF A01.

From Workshop on the production of new particles in super high energy collisions; Madison, WI, USA (22 Oct 1979).

A conceptual design, and design criteria are presented for a dipole detector for ISABELLE. (GHT)

14089 (FERMILAB—80/1) **Fermilab report.** (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1980. Contract EY-76-C-02-3000. 21p. Dep. NTIS, PC A02/MF A01.

Activities at Fermilab during 1979 are briefly described, including main ring magnet performance, operations summary, beam utilization summary, and a list of manuscripts and notes prepared from December 13, 1979 to January 14, 1980. (GHT)

14090 (ORO—3956-9) **Bubble chamber studies of hadron and photon interactions. Progress report, April 1, 1979-March 31, 1980.** Bugg, W.M.; Condo, G.T.; Handler, T.; Hart, E.L. (Tennessee Univ., Knoxville (USA)). 1980. Contract EY-76-S-05-3956. 12p. Dep. NTIS, PC A02/MF A01.

Research during the period April 1979 through March 1980 by the University of Tennessee Bubble Chamber Group is described. (GHT)

14091 **Commissioning of the Argonne intense pulsed neutron source (IPNS-I) accelerator.** Rauchas, A.V.; Brunwell, F.R.; Volk, G.J. (Argonne Natl Lab, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3006-3008(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The IPNS-I 500 MeV Rapid Cycling Synchrotron (RCS) was commissioned during March of 1977. It was originally designed as an injection energy booster for the Zero Gradient Synchrotron (ZGS), as well as a source of high intensity proton beams for neutron production. With the termination of the high intensity operation of the ZGS, the accelerator became a dedicated machine for neutron physics. After a period of tuning and improving accelerator components, the accelerator officially began neutron physics experiments on July 1, 1978. The accelerator has achieved a repetition rate of 15 Hz with beams of 1*10;sup 12; protons delivered on target. Operation at 30 Hz is expected soon. A description of the accelerator is presented. Turn on procedures, operating experience and initial performance problems are also discussed. 10 refs.

14092 **500 kV mercury accelerator.** Brodowski, J.; Maschke, A.W.; Mobley, R.M.; Keane, J.T.; Meier, E. (Brookhaven Natl Lab, Upton, NY). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3039-3041(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The objective of building a low-cost pre-accelerator for low energy heavy ion particle accelerator was realized by using standard, readily available material and hardware. Some savings were obtained in the construction of the dome by avoiding welding, expensive metal spinnings and unnecessary corona rings. Larger monetary economies were realized by a unique approach to building the high voltage column utilizing a glass tube. 1 ref.

14093 **Electron beam for the Fermilab electron cooling experiment.** Hermannsfeldt, W.B.; Kells, W.; McIntyre, P.M.; Mills, F.; Misek, J.; Oleksiuk, L. (Stanford Univ, Calif). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3237-3240(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A description is given of the design and construction of the electron beam for the Fermilab Electron Cooling Experiment. Important parameters are (1) 110 keV kinetic energy; (2) 26 A current; (3) 0.5 eV rest frame temperature; (4) space charge neutralization; (5) beam modulation; (6) efficient energy recovery at the collector. The 5 m overlap region between the electron beam and the storage ring orbit represents 4% of the total ring circumference. 3 refs.

14094 **Injection, magnet, and vacuum systems for the Fermilab antiproton cooling ring.** Gannon, J.C.; Gray, E.R.; Klen, J.; Mills, F.E.; Moore, C.D.; Rhoades, T.; Snowdon, S.; Young, D.E. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3241-3243(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Construction details are given for the dipole and quadrupole magnets, a brief description of the proton injection line, and a short report of the vacuum system design for the existing Fermilab Cooling Ring.

14095 **Electron-proton colliding beams at Fermilab.** Ruggiero, A.G. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3258-3260(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

A description is given of a design study for an electron-proton colliding beam facility at Fermi National Accelerator Laboratory. 1 ref.

14096 **Microprocessor-based control facility of the He refrigerator system used in the 1000 GeV Fermilab switchyard.** Tummillo, A.F.; Oetting, E.R.; Andrews, R.A.; McCarthy, J. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3316-3318(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Because of Fermilab's early commitment to computer control and monitoring, several very large control systems have evolved. The continually expanding size of these systems has begun to tax some of the central computers almost to their limits. The control and monitoring requirements of the refrigeration system were of such a nature that distributed processing became an attractive way to alleviate the overloading of the central computer that the helium liquefier would have presented. A description is given of the hardware and software that were necessary to implement the distributed processing concept.

14097 **Modifications to the Fermilab booster-main ring beam transfer phase lock circuit.** Bridges, J.F. (Fermi Natl Accel, Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3337-3339(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Modifications have been made to the circuit which phase locks the Booster Accelerator beam to the Main Ring Accelerator RF oscillator used during injection time. The improvement in the transient response allowed the Booster RF voltage amplitude to be lowered to match the bucket shape to the Main Ring bucket shape. Effects of the RF cavity bandwidth and the delay time in the Booster RF system are discussed. 6 refs.

14098 **Broadrange beam signal limiter for the Fermilab booster.** Higgins, E.F. Jr. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3373-3375(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The raw beam signal is not suitable for direct application to the phase lock circuits without prefiltering and conditioning for amplitude stability. In practice, a "constant delay" rf limiter/filter is used to stabilize the beam signal and remove objectionable harmonic content prior to application to the phase lock circuits. This study discusses the general problem of beam signal limiting as it applies to the frequency lock loop, gives the details of the limiter used, and presents specific characteristics of the device used in the booster synchrotron.

14099 Beam detector assembly for the Fermilab energy doubler. Higgins, E.F. Jr.; Nicol, T.H. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3426-3429(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The testing and production of the Fermilab Energy Doubler has necessitated the development of a detection device to locate a proton beam with an accuracy and repeatability of ;plus or minus;.5 mm relative to the centerline of a 2-7/8 inch bore tube. This information is essential for focusing and "steering" of the beam around a four mile synchrotron. The detectors are positioned, to measure horizontal and vertical off-axis displacement, alternately at each quadrupole magnet. The severity of the operating environment, as well as stringent electrical parameters, have necessitated the development of a number of design innovations. Both the mechanical and electrical considerations are discussed as they relate to operational criteria.

14100 Current to frequency converter for digitization of millisecond beam signals. Donaldson, A.R. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3439-3441(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

Beam-intensity monitoring in the Fermilab Neutrino Area requires sensitive and fast processing for beam signals (with four or five decade amplitude variations for a typical detector) which are digitized with a current-to-frequency converter (IFC). The converter digitizes the input charge at a 1 pC/Hz rate with a processing limit at 10 MHz for a 10 nC charge input or a 10 ;mu;A current input. For a 1 ms beam pulse, the IFC can generate a 1 to 10,000 count output. The digitizer is two to three decades more sensitive than the fastest commercial V to F converters and the upper frequency limit is two or three decades higher than the present laboratory built IFC's. The resolution over the 0 to 50 C temperature range and the linearity from 1 Hz to 1 MHz is held to ;plus or minus;1% with a linearity deviation of +5% at 10 MHz. 3 refs.

14101 Microprocessor based beam intensity and efficiency display system for the Fermilab accelerator. Biwer, R. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3448-3450(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The Main Accelerator display system for the Fermilab accelerator gathers charge data and displays it including processed transfer efficiencies of each of the accelerators. To accomplish this, strategically located charge converters monitor the circulating internal beam of each of the Fermilab accelerators. Their outputs are processed via an asynchronously triggered, multiplexed analog-to-digital converter. The data is converted into a digital byte containing address code and data, then stores it into two 16-bit memories. One memory outputs the interleaved data as a data pulse train while the other interfaces directly to a local host computer for further analysis. The microprocessor based display unit synchronizes displayed data during normal operation as well as special storage modes. The display unit outputs data to the fron panel in the form of a numeric value and also makes digital-to-analog conversions of displayed data for external peripheral devices. 5 refs.

14102 Holifield Heavy Ion Research Facility--Phase II. Ball, J.B.; Hudson, E.D.; Lord, R.S.; Johnson, J.W.; Martin, J.A.; McNeilly, G.S.; Milner, W.T.; Mosko, S.W.; Sayer, R.O.; Robinson, R.L. (Union Carbide Corp). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3727-3729(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The Holifield Heavy Ion Research Facility, with the completion of Phase I in late 1979, will include the Oak Ridge Isochronous Cyclotron (ORIC) and associated Research areas, the new 25 MV tandem accelerator with new research areas for tandem beams, and modifications to utilize the ORIC as a booster accelerator. A discussion is presented of plans for a Phase II expansion of the facility to include an isochronous cyclotron with superconducting magnet and reconfiguration of the existing research areas and the ORIC vault to handle the higher energy beams from the new cyclotron. The new booster cyclotron is a low-flutter high-spiral design patterned after the MSU K=800 design, with a central magnetic field of about 5 tesla and an extraction radius of 1 meter. 10 refs.

STORAGE RINGS

REFER ALSO TO CITATION(S) 14065, 14078

14103 Report on the operational reliability of the Fermilab main ring magnets. Gerig, R.E. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3161-3163(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

This report presents the magnet failure statistics for the past seven years and draws conclusions as to what is expected in the future for each fabrication technique. Operational conditions at the time of each failure have been recorded for the past two years, and this information has been used to make hardware changes and procedural changes to reduce the number of failures resulting from causes external to the magnet. A black listing technique is used to find magnets which are close to failure; these magnets are removed during maintenance periods to prevent interruption to the physics program. 4 refs.

14104 Doubler-tevatron ;mu;p quench protection system. Flora, R.H.; Tool, G.S. (Fermi Natl Accel Lab, Batavia, Ill). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 3451-3453(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

1014 superconducting magnets, distributed around a four mile ring and storing a total energy of 1/3 GJ, are to be protected by six microprocessor monitors. During a quench, the monitors initiate global shutdown and selectively activate individual protection heaters. During normal operation, they actively test major protection components for proper operation and aid in the cooldown and warmup process. The high priority safety scan assembly language programs are time slided with the low priority BASIC language operator and central computer interface programs. The monitors themselves are continuously checked for proper operation by "heartbeat" detectors. 3 refs.

INSTRUMENTATION

RADIATION INSTRUMENTATION

14105 Laboratory computer system for routine, plant, and environmental radiation-monitoring applications. Myers, W.R.; English, G.O.; Morneau, R.A. (Idaho National Engineering Lab., Idaho Falls, ID). pp 216-222 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

This paper describes a PDP-15 computer system used to support the varied activities of the Radiation Measurements Laboratory located in the Test Reactors Area at the Idaho National Engineering Laboratory (INEL). These activities include providing technical assistance to the test reactors and to various groups in counting laboratories, maintaining radiation measurement standards, measuring flux distributions, gamma heating, and other in-pile parameters in the test reactors and associated loop experiments, and developing measurement techniques required in support of test reactor programs. It also describes the implementation of remotely controlled gamma-ray spectrometers and the necessary communications network to provide on a routine basis effluent monitoring for reactor facilities at INEL.

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 13557, 13598, 14121, 14130, 14202

14106 (BNL—27092) Low cost radioiodine air sampling system for nuclear incidents: experience at Three Mile Island. Distenfeld, C.; Klemish, J. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 7p. (CONF-791037—21). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

Costly measurement methods using gamma analysis can be avoided by developing a sample specifically for iodine, thereby permitting any beta or gamma detector to be used for measurement. Particulate fission products include dozens of noniodine radionuclides. Use of a prefilter before the adsorber bed separates the

activity into gaseous and particulate fractions, and allows a determination of gaseous radioiodine. Adsorption of fission gases relative to iodine can be reduced by using an appropriate inorganic adsorber. Several commercial inorganic adsorbers were tested, but were too expensive or inefficient for the organic or hypoiodous acid forms of iodine. A silver impregnated silica gel adsorber was developed that had over 90% efficiency for collection of radioiodine for sampling times of several minutes.

14107 (LA—7987-MS) **Contribution of carbon interactions to the neutron counting efficiency of organic scintillators.** Drosg, M.; Drake, D.M.; Lisowski, P. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

The neutron counting efficiency of an NE-213 detector was measured for neutron energies up to 15 MeV using biases at 0.3- and 2.0-MeV neutron energies. For the lower bias, nonelastic carbon interactions contribute appreciably to the efficiency at energies as low as 5.5 MeV.

14108 (UCD—472-125, pp 165-167) **Automatic sample changer and microprocessor controlled data router for a small bulk-sample counter.** Parks, N.J.; Schwind, J.A.; Hinz, E.A. Oct 1979.

In Annual report, 1978-1979.

We have designed a gamma-ray counting system for small bulk-samples that incorporates an automatic sample-changer and multiple data-output device. The system includes an inexpensive microprocessor and is constructed mainly of materials and equipment commonly available at most institutions engaged in nuclear research.

14109 (UCID—18294) **Limitations of retarded (bisulfite) x-ray film processing.** Stoering, J.P.; Dittmore, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Oct 1979. Contract W-7405-ENG-48. 6p. Dep. NTIS, PC A02/MF A01.

We demonstrate the limitations of using retarded (bisulfite) developer to abate film sensitivity of x-ray films that have been exposed to intense radiation. We compared the measured densities of a large number of Kodak Type-M x-ray film samples exposed to a known fluence of monochromatic x-rays. These film samples were processed in three separate batches of bisulfite developer mixed in the same proportions. We concluded that reproducible film-density information cannot be obtained using different batches of (bisulfite) developer solutions.

14110 (UCRL—50025-79-3, pp 14-20) **X-ray monitor and control system detects failures in x-ray operations.** 30 Sep 1979.

In Electronics Engineering Department. Quarterly report No. 3, 1979.

Accidents involving exposure of operating personnel to hazardous levels of radiation may be as high as 1 exposure per year per 100 x-ray operating systems. During the past 10 years, LLL has had only two minor exposures, one with clinical symptoms and one with no clinical symptoms. To further reduce the potential of accidental exposures, the X-Ray Monitor and Control System that detects failures within the x-ray operating system, warns the operating personnel of abnormal conditions, and disconnects the supply power to the system was developed. LLL has installed this control system on 54 of 86 x-ray systems.

14111 **Cloud chambers: expansion and diffusion.** Shutt, R.P. (Brookhaven National Lab., Upton, NY (USA)). *Nucl. Instrum. Methods;* **162**: No. 1-3, 379-388(1979).

The author presents a short description of the operational features of cloud chambers and their application in experiments. Details, illustrations, and references to the vast amount of research publications in the various fields are given.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

REFER ALSO TO CITATION(S) 13952

14112 (BNL—26893) **Brookhaven National Laboratory's multiparticle spectrometer drift chamber system.** Etkin, A.; Kramer, M.A. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 6p. (CONF-791037—22). Dep. NTIS, PC A02/MF A01.

From IEEE nuclear science symposium; San Francisco, CA, USA (17 Oct 1979).

A system of drift chambers is being built to replace the present spark chambers in the Brookhaven National Laboratory's Multiparticle Spectrometer. This system will handle a beam of ~ 3 million particles per second and have a resolution of 200 μm. A summary of the status of the chambers and the custom integrated circuits is presented. The data acquisition system is described. Prototype chambers have been built and tested with results that are consistent with the expected chamber properties.

14113 **Windowless stabilization scheme for computerized pulse-height analyzers.** Cohn, C.E. (Argonne National Lab., Argonne, IL). pp 426-429 of Computers in activation analysis and gamma-ray spectroscopy. Carpenter, B.S.; D'Agostino, M.D.; Yule, H.P. (eds.). Washington, DC; Department of Energy (1979).

From Conference on computers in activation analysis and gamma-ray spectroscopy; Mayaguez, Puerto Rico (30 Apr 1978).

A new stabilization scheme requires neither windows nor circuits for generating correction voltages. A precision pulse generator produces tagged reference pulses alternately of high and low amplitude. As each reference pulse is processed, a gain correction factor and a zero correction term are calculated so as to correct these back to the averages obtained at the beginning of the run. The corrections are also applied to each normal event.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 14470

14114 (LA—8165-MS) **Time projection spectrometer.** Anderson, H.L. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 8p. (CONF-790126—5). Dep. NTIS, PC A02/MF A01.

From LAMPF workshop on Pion Single Charge Exchange; Los Alamos, NM, USA (22 Jan 1979).

The time projection chamber (TPC) is discussed. Its advantage is its ability to collect a great deal of information on multiparticle reactions from high-energy colliding beam experiments. The TPC makes it possible to reconstruct all the charged particles in the reaction, and it can be used for mass identification. (FS)

14115 **Low intensity x-ray and gamma-ray imaging device.** Yin, L.I. US Patent 4 142 101. 27 Feb 1979. Filed date 20 Jul 1977. 9p.

A radiation to visible light converter is combined with a visible light intensifier. The converter is a phosphor or scintillator material which is modified to block ambient light. The intensifier includes fiber optics input and output face plates with a photocathode-microchannel plate amplifier-phosphor combination. Incoming radiation is converted to visible light by the converter which is piped into the intensifier by the input fiber optics face plate. The photocathode converts the visible light to electrons which are amplified by a microchannel plate amplifier. The electrons are converted back to light by a phosphor layer and piped out for viewing by the output fiber optics faces plate. The converter-intensifier combination may be further combined with its own radiation source or used with an independent source.

14116 **Streamer chambers - their use for nuclear science experiments.** Schroeder, L.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Instrum. Methods;* **162**: No. 1-3, 395-404(1979).

A review of the role of streamer chambers in nuclear science work is presented. Included is a brief description of the operating principles of such chambers, some advantages and drawbacks of employing this visual detector for nuclear science experiments, and a discussion of the future usefulness of such devices; both for hadron-nucleus and nucleus-nucleus studies. Several examples of the interactions of both hadron and heavy ion beams with nuclear targets located in a streamer chamber are shown.

RADIOMETRIC INSTRUMENTS

14117 (LA—8084) **Automated determination of irradiated fuel pin centerlines for gamma scanning.** Barnes, B.K.; Quintana, J.N.; Murray, A.S. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 10p. Dep. NTIS, PC A02/MF A01.

A method is described for calculating the centerlines of irradiated fuel pins to be analyzed by gamma scanning. Fuel pin centering has been automated by computer control through a CAMAC link to the scanning mechanism. Rapidity and accuracy of the gamma scanning process have been improved by replacing the former trial and error method with this automated technique.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

14118 **Comparison of gamma-irradiation-induced degradation in amphoterically si-doped GaAs led's and Zn-diffused GaAs led's.** Barnes, C.E. (Sandia Lab, Albuquerque, NM). *IEEE Trans. Electron Devices;* **ED-26**: No. 5, 739-745(May 1979).

It is shown that the light output of GaAs:Si LED's is severely degraded by irradiation, and, in addition, that the light output cannot be recovered through forward-bias-induced annealing. In contrast, commercially available dome-shaped GaAs:Zn emitters with comparable power outputs degrade much less, and the degradation that is observed can be recovered by forward-bias-induced annealing. Further, this bias-induced recovery can be achieved by applying for-

ward-current pulses only 10 to 50 ms in width. The lack of any bias-induced recovery in the GaAs;Si devices led to an investigation of gamma-induced deep levels using the transient capacitance method of deep level transient spectroscopy (DLTS). Following irradiation, two levels with thermal activation energies of 0.21 and 0.78 eV were observed. Subsequent forward bias reduced the concentration of the 0.21-eV level but had relatively little effect on the 0.78-eV level. These results suggest that the near midgap 0.78-eV level is one of the nonradiative recombination centers responsible for light output degradation.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 12986, 13901, 14010, 14109, 14148, 14161

14119 (CERN—78-13, pp 50-64) **Software for microcircuit systems.** Kunz, P.F. (Stanford Linear Accelerator Center, CA (USA)). 28 Nov 1978.

In 1978 CERN school of computing. Proceedings of the school held in Jadwisin, Poland, 28 May - 10 June 1978.

Modern Large Scale Integration (LSI) microcircuits are meant to be programmed in order to control the function that they perform. In the previous paper the author has already discussed the basics of microprogramming and have studied in some detail two types of new microcircuits. In this paper, methods of developing software for these microcircuits are explored. This generally requires a package of support software in order to assemble the microprogram, and also some amount of support software to test the microprograms and to test the microprogrammed circuit itself.

14120 (CONF-791018—2) **Experimental study of virtual impactors.** Yule, T.J.; Broniarck, C.G. (Argonne National Lab., IL (USA); Rensselaer Polytechnic Inst., Troy, NY (USA)). 1979. Contract W-31-109-ENG-38. 29p. Dep. NTIS, PC A03/MF A01.

From Symposium on advances in particulate sampling and measurement; Daytona Beach, FL, USA (7 Oct 1979).

Virtual impactors are currently being used in a number of instruments to separate an aerosol into different size ranges. The virtual impactor is a variation of the standard impactor in which the impaction surface is replaced by an orifice into which particles can pass and be collected or counted. We have made an experimental study of the collection characteristics of virtual impactors. The parameters varied included: acceleration nozzle-to-collection probe distance, the ratio of the collection probe-to-acceleration nozzle diameters, and the ratio of collection probe-to-inlet flows. Measurements were also made with different collection probe geometries. It was found that it is possible to parameterize much of the data by introduction of the Stokes number and an effective minor flow collection efficiency. One disadvantage of the virtual impactor is that in the transition region particles are collected on the inside walls of the collection probe near the probe tip. The amount that is collected is a sensitive function of the probe geometry.

14121 (CONF-791118—7) **Pulsed neutron activation calibration technique.** Kehler, P. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 13p. Dep. NTIS, PC A02/MF A01.

From 7. water reactor safety research information meeting; Gaithersburg, MD, USA (5 Nov 1979).

A pulsed neutron activation (PNA) for measurement of two-phase flow consists of a pulsed source of fast neutron to activate the oxygen in a steam-water mixture. Flow is measured downstream by an NaI detector. Measured counts are sorted by a multiscaler into different time channels. A counts vs. time distribution typical for two-phase flow with slip between the two phases is obtained. Proper evaluation for the counts/time distribution leads to flow-regime independent equations for the average of the inverse transil time and the average density. After calculation of the average mass flow velocity, the true mass flow is derived. (FS)

14122 (COO—119-254, pp 82-126) **Gamma-ray spectrometry of humans.** Lloyd, R.D.; Mays, C.W.; Taysum, D.H. 31 Mar 1979.

In Research in radiobiology. Annual report of work in progress in the internal irradiation program.

A human total-body counter was designed and built with two 20 x 10 cm NaI(Tl) crystals suspended over an isoresponse surface upon which the subject reclines. This surface is curved from head to knee and from left to right, so that a gamma-ray emitting object is detected with equal efficiency when placed anywhere upon it. The positioner and detectors are housed in a low background enclosure constructed of steel 31 cm thick with a graded inner lining of lead + cadmium + copper. Calibration of the system was accomplished by administering trace amounts of various radionuclides to 48 human subjects of various sizes, ranging in age from 4 to 80 years. Counting rates per retained μCi at 0.53, 0.66, 1.53, and 2.75 MeV (^{83}Rb, ^{137}Cs, ^{42}K, and ^{24}Na) were determined as a function of body size and were compared with counting rates per μCi of corresponding emitters centered in a polyethylene cylinder of radius 10.3 cm. Limits of detection, corresponding to 3 times the standard deviation of a 50 minute background, were 170 nCi ^{90}Sr (via Bremsstrahlung x-rays), 0.78 nCi ^{131}I, 0.48 nCi ^{83}Rb, 0.52 nCi ^{137}Cs, 4.9 nCi ^{40}K (or 5.8 g of natural potassium), and 1.7 nCi ^{222}Rn.

14123 (DOE/ER/10393—1) **Improved instrument for the measurement of the thermal conductivity of non-electrolyte liquids. Progress report No. 1, May 1, 1979-January 15, 1980.** Sloan, E.D.; Graboski, M.S. (Colorado School of Mines, Golden (USA)). 1980. Contract AC02-79ER10393. 27p. Dep. NTIS, PC A03/MF A01.

An improved instrument for the measurement of the thermal conductivity of non-electrolyte liquids was designed and constructed. Eventually the apparatus will be tested and the thermal conductivity of two coal-derived synthetic oils will be measured. (FS)

14124 (LA-UR—79-3349) **Microprocessors applications in the nuclear industry.** Ethridge, C.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 9p. (CONF-800201—4). Dep. NTIS, PC A02/MF A01.

From COMPCON 1980; San Francisco, CA, USA (25 Feb 1980).

Microprocessors in the nuclear industry, particularly at the Los Alamos Scientific Laboratory, have been and are being utilized in a wide variety of applications ranging from data acquisition and control for basic physics research to monitoring special nuclear material in long-term storage. Microprocessor systems have been developed to support weapons diagnostics measurements during underground weapons testing at the Nevada Test Site. Multiple single-component microcomputers are now controlling the measurement and recording of nuclear reactor operating power levels. The CMOS microprocessor data-acquisition instrumentation has operated on balloon flights to monitor power plant emissions. Target chamber mirror-positioning equipment for laser fusion facilities employs microprocessors.

14125 (LA-UR—80-278) **Ground based automated telescope.** Colgate, S.A.; Thompson, W. (Los Alamos Scientific Lab., NM (USA); New Mexico Inst. of Mining and Technology, Socorro (USA)). 1980. Contract W-7405-ENG-36. 12p. (CONF-800116—1). Dep. NTIS, PC A02/MF A01.

From Optical and infrared program conference; Tucson, AZ, USA (7 Jan 1980).

Recommendation that a ground-based automated telescope of the 2-meter class be built for remote multiuser use as a natural facility. Experience dictates that a primary consideration is a time shared multitasking operating system with virtual memory overlayed with a real time priority interrupt. The primary user facility is a remote terminal networked to the single computer. Many users must have simultaneous time shared access to the computer for program development. The telescope should be rapid slewing, and hence a light weight construction. Automation allows for the closed loop pointing error correction independent of extreme accuracy of the mount.

14126 (NUREG/CR—1031) **Stress and duress monitoring at NRC-licensed facilities.** Fainberg, A. (Brookhaven National Lab., Upton, NY (USA)). 11 Sep 1979. Contract EY-76-C-02-0016. 30p. (BNL-NUREG—51089). Dep. NTIS, PC A03/MF A01.

Various current and near-future methods of detecting stress in humans are evaluated as to effectiveness and cost with a view to application as a screening mechanism at portals at NRC-licensed facilities. Also, similar and related techniques of stress detection and covert switches are evaluated for use by guards at NRC-licensed facilities as methods of informing the Central Alarm Station that the guard is under duress.

14127 (PB—294926) **HUD utilities demonstration series. Volume nine. Description of the data acquisition and instrumentation systems: Jersey City total energy project.** Bulik, C.; Rippey, W.G.; Hurley, C.W.; Rorrer, D.E. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Mar 1979. 161p. NTIS PC A08/MF A01.

This report describes the design and operation of the instrumentation system and the data acquisition system used to monitor the total energy plant and certain utility services to the site buildings. The report contains a description of the types, characteristics and locations of instruments used to measure physical variables. The capabilities and operational modes of the data acquisition system components are described in detail. The report also contains a brief description of the total energy plant and site, instrument costs, data processing procedures and some of the instrumentation problems encountered.

14128 (SAND—79-0259) **Environmental evaluation of three multi-transceiver ultrasonic intrusion detectors: advisor VI, contronic MD 440, and detection systems DS-600.** (Sandia Labs., Albuquerque, NM (USA)). Jan 1979. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

A series of tests was performed on the Advisor VI, Contronic MD 440, and Detection Systems DS-600 multi-transceiver ultrasonic intrusion detection sensors to evaluate their performance under differing environmental conditions. The results are presented as a series of graphs which plot intruder radial velocity versus temperature. The resultant curves can be used to determine whether detector range adjustments are necessary to compensate for temperature fluctuation.

14129 (SAND—79-1322) **Development of a centrifuge to simulate the spin environment of artillery shells containing telemetry.** Kannolt, J.R.; Dunn, D.L. (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 23p. Dep. NTIS, PC A02/MF A01.

A centrifuge and associated equipment developed for active testing of electronic components and assemblies in simulated artillery-shell spin environments of up to 20,000 rpm are described. The centrifuge drive system, spindle and slip-ring module, test unit fixturing, rotor orbit-monitoring system, and safety features are described.

14130 (UCID—18516) **Photocathode fatigue of L-24 PM head due to high intensity light pulses.** Bailey, K.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Jan 1980. Contract W-7405-ENG-48. 53p. Dep. NTIS, PC A04/MF A01.

The sensitivity of radiation detectors which utilizes photomultipliers was determined after exposing the multiplier phototubes to high intensity light pulses. Test results found that generally less than a 5% change was found. (FS)

14131 (UCRL—50025-79-3) **Electronics Engineering Department. Quarterly report No. 3, 1979.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1979. Contract W-7405-ENG-48. 25p. Dep. NTIS, PC A02/MF A01.

Separate abstracts have been prepared for the four papers in this report.

14132 (UCRL—50025-79-3, pp 10-13) **Analysis and management system improves data handling of water samples.** 30 Sep 1979.

In Electronics Engineering Department. Quarterly report No. 3, 1979.

The US Geological Survey (USGS) annually analyzes the quality of thousands of water samples from throughout the United States to determine pollutant concentrations. The load is increasing, creating large backlogs of outstanding samples. New instruments are generating more parameter determinations in less time, thereby increasing the data-handling problems. To help alleviate these problems, a sample analysis and management system for the USGS was developed.

14133 (UNI—1318) **Ultrasonic flowmeters. Interim progress report.** Wittekind, W.D.; Toffer, H. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 31 Jan 1979. Contract EY-76-C-06-1857. 28p. Dep. NTIS, PC A03/MF A01.

Ultrasonic flow measuring and flow characterization methods were studied for use in flows of primary coolant, secondary water and auxiliary water systems because this method does not require penetration or alteration of the fluid containment structure. An evaluation of commercially available equipment is given and testing of the equipment is described. (FS)

14134 (JPRS—72976) **Integrated circuits in nanosecond nuclear electronics.** Meleshko, E.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Mar 1979. Translation of Integral'nye Skhemy v Nanosekundnoi Yadernoi Elektronike, Moscow, 1977.;. 147p. Paper copy also available on standing order, deposit account required, North American Continent price $7.00/each issue, all others write for quote.

The report contains information on problems of designing various devices in nanosecond nuclear electronics on the basis of integrated circuitry. Basic types of high-speed integrated circuits are considered, along with techniques for using them as the basis in designing fast amplifiers, shapers, and discriminators of nanosecond pulses, as well as high-speed logic devices. Principal attention is concentrated on the use of integrated circuits based on current switches. The author considers various time interval converters with nanosecond and subnanosecond resolving capacities, and also high-speed counters based on integrated circuits. Circuits are given for pulse generators with a high recurrence rate, and timers.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

14135 (LA-UR—80-56) **Flowing afterglow spectroscopy: an ultrasensitive probe into solid-phase decomposition kinetics.** Taylor, G.W.; Andrews, G.H. Jr. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 30p. (CONF-791079—3). Dep. NTIS, PC A03/MF A01.

From 7. DOE compatibility meeting; Aiken, SC, USA (16 Oct 1979).

The thermal-decomposition kinetics of high explosives are important to manufacturers and handlers of these dangerous materials from the standpoint of processing and storage. Two broad temperature regions are of particular importance, i.e., the high ($\geq 200^0$C) temperature region associated with fire hazard and the low ($\sim$ 20 to 200°C) region associated with storage and processing environments. The paper describes the technique in detail and summarizes recent efforts to elucidate the low-temperature kinetics of trinitrotriaminobenzene (TATB) and nitroguanidine (NQ).

14136 (UCID—18534) **Preliminary development and characterization of a TATB/HMX plastic-bonded explosive.** Hornig, H.C.; McGuire, R.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 26p. Dep. NTIS, PC A03/MF A01.

Three new explosives were devised, prepared, and partially characterized in an attempt to find a favorable compromise between the extreme safety but modest detonation performance of TATB and the modest safety but excellent detonation performance of HMX. The three new formulations were all TATB/HMX/Binder - 45/48.5/6.5 vol % with Viton A and Kraton-1650 used as binders, and with two granulations of HMX, Class E, and LX-04 grade. In safety tests with frictional impact such as Susan and bullet tests, the new explosives resemble TATB-based explosive with high threshold and low reactivity. In high-temperature tests, the threshold temperature is similar to that for HMX-based explosive; but the reactions are mild, resembling TATB-based explosive. When the explosive is heated and confined under pressure, these reactions result in a gas rupture of the pressure vessel. Initiation to detonation from the strong short shock of a thin flyer plate resembles HMX-based explosive; but in the small-scale gap test, the materials behave similarly to Composition B. The effect of the smaller particle size of Class E HMX was barely discernible in some tests and undetected in others. Cylinder test energy and the equation of state is similar to that of Composition B, and calculations indicate that energy is linear with HMX concentration. Most safety properties are non-linear, and these materials are substantially safer than Composition B under accident-type stimuli tested to date. The family offers an unusual opportunity for tailoring or trading off properties because, in reference to HMX concentration, energy is linear, hazard properties seem to be on the less sensitive or TATB side of linear, and strong shock initiation seems to be on the more sensitive or HMX side of linear.

14137 (UCRL-Trans—11510) **Relation between the electronic structure and the shock sensitivity of nitrated secondary explosives. III. Influence of the crystal environment.** Delpuech, A.; Cherville, J. Translated from *Propellants Explos.;* **4**: 61-65(1979). 21p. Dep. NTIS, PC A02/MF A01.

A study of the influence of crystal interactions on the molecular parameters correlated with the shock sensitivity are described. The results obtained permit more precise statement of the roles of the molecule and of the crystal respectively at the time of initiation of the detonation. They show that in this area, the conclusions drawn from calculations on an isolated molecule in its crystalline conformation are valid for the whole crystal.

NUCLEAR

REFER ALSO TO CITATION(S) 14005, 14049, 14153

14138 (AD-A—063113) **The effects of air and ground Composition perturbations upon energy deposition rates and compton electron currents from a surface burst. Final report, 17 November 1976-10 November 1978.** Beer, M.; Cohen, M.O.; Troubetzkoy, E.S. (Mathematical Applications Group, Inc., Elmsford, NY (USA)). Dec 1978. Contract DAAG39-77-C-0020. 38p. NTIS, PC A03/MF A01.

A series of time-dependent Monte Carlo perturbation calculations has been performed to determine, as functions of neutron source energy band, the energy deposition rates and Compton electron sources in the air due to neutron and secondary photon interactions from weapons at a one meter height of burst. Both total value and composition perturbation differences were calculated for atmospheric water volume fractions of 2% and 4%. Nevada test soil was used for the base case ground composition. The small perturbations considered were water in air and water, silicon, aluminum and iron in ground. The energy deposition rates and Compton electron sources were determined as functions of time (out to 100-ms local

time), in 49 radial and altitude scoring bins surrounding the four isotropic point sources. Answers were obtained for penetrations from 0 to 2.4 km in the horizontal direction and from 0 to 1.5 km above the air-ground interface. The raw data have been stored on tapes at HDL. Some sample results are presented and described in this report. More analysis is required to obtain further results.

14139 (AD-A—067218) **Cost and feasibility evaluation for the excavation of large hemispherical cavities in Rainier Mesa. Topical report, January-October, 1978.** Kipp, T.R.; Kennedy, R.P. (Engineering Decision Analysis Co., Inc., Irvine, CA (USA)). Oct 1978. Contract DNA001-78-C-0281. 206p. NTIS PC A10/MF A01.

In order to provide necessary facilities for the fielding of experiments in support of the underground nuclear testing program, there has been an increase in interest concerning the construction of large underground caverns in Rainier Mesa. As a result, a cost and feasibility program was commissioned to evaluate hemispherical cavities between 24.4 and 91.4 m (80 and 300 ft) in diameter. The rock support designs for the cavities are based upon the use of internally installed rockbolts for the smaller cavities and tendons installed from annular galleries for the larger chamber. The evaluation program included research into past experience pertaining to the excavation and support of large underground caverns, assessment of the geological conditions which exist in Rainier Mesa, preliminary design of the cavities and their rock support system based upon the geological setting, development of mining plans for the excavation of the caverns, and estimation of the cost and manpower schedule to complete the construction of each size chamber based upon the preliminary design and mining approach. This report presents the findings of the cost and feasibility evaluation program and includes recommendations concerning the maximum practical chamber size considering schedule, dollar, and state-of-the-art constraints.

14140 (EGG—1183-1757, pp 73-89) **Photocathode development.** Hinrichs, C.K.; Estrella, R.M. Dec 1979.

In Research and Development FY 1979 final report.

A research program for the development of photocathodes for use in streak image tubes is described. This is one task in the development of a high-resolution, high-speed x-ray streak camera system whose primary application is for diagnostics in underground nuclear testing. There are three objectives in the photocathode development program: (1) the development of new x-ray photocathodes compatible with the requirements of streak tubes; (2) the development of the capability to process high-quality visible light photocathodes as well as x-ray photocathodes; and (3) the design and construction of a transfer photocathode system. Design and construction of all the major components of the transfer photocathode system were completed. Assembly should be completed in early FY 80.

14141 (EGG—1183-1757, pp 91-107) **Streak tube development.** Hinrichs, C.K.; Estrella, R.M. Dec 1979.

In Research and Development FY 1979 final report.

A research program for the development of a high-speed, high-resolution streak image tube is described. This is one task in the development of a streak camera system with digital electronic readout, whose primary application is for diagnostics in underground nuclear testing. This program is concerned with the development of a high-resolution streak image tube compatible with x-ray input and electronic digital output. The tube must be capable of time resolution down to 100 psec and spatial resolution to provide greater than 1000 resolution elements across the cathode (much greater than presently available). Another objective is to develop the capability to make design changes in tube configurations to meet different experimental requirements. A demountable prototype streak tube was constructed, mounted on an optical bench, and placed in a vacuum system. Initial measurements of the tube resolution with an undeflected image show a resolution of 32 line pairs per millimeter over a cathode diameter of one inch, which is consistent with the predictions of the computer simulations. With the initial set of unoptmized deflection plates, the resolution pattern appeared to remain unchanged for static deflections of +- 1/2-inch, a total streak length of one inch, also consistent with the computer simulations. A passively mode-locked frequency-doubled dye laser is being developed as an ultraviolet pulsed light source to measure dynamic tube resolution during streaking. A sweep circuit to provide the deflection voltage in the prototype tube has been designed and constructed and provides a relatively linear ramp voltage with ramp durations adjustable between 10 and 1000 nsec.

14142 (EGG—1183-1757, pp 109-121) **Optical instrumentation studies.** Norris, N. Dec 1979.

In Research and Development FY 1979 final report.

Development of advanced experimental facilities are needed to carry out more fundamental transient radiation investigations than previously possible on optical components for weapons test applications. A facility offering a picosecond optical source that is synchronously locked to a linear accelerator radiation pulse source has been demonstrated and is described. A large bandwidth streak camera recording system is also described that has been developed and which operates synchronously with the facility systems. Results of an investigation of fiber optics lightguide response to Febetron radiation are presented. The study was undertaken to improve laboratory techniques for measuring prompt radiation response of fibers and to obtain data that more adequately predicts fiber performance in the downhole nuclear environment. Implementation was investigated of a high bandwidth data encoding scheme that employs low frequency detection and recording components. A theoretical feasibility analysis was completed and a practical feasibility test is scheduled. The system and its status are described.

CIVIL USES

14143 (UCID—18535) **Excavation of a Qattara Canal in Egypt: two-dimensional nuclear cratering calculations.** Bryan, J.B.; Burton, D.E.; Lettis, L.A. Jr.; Bruce, A.L.; Moreno, L.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 80p. Dep. NTIS, PC A05/MF A01.

A series of single-charge nuclear cratering calculations were performed. Results from these calculations are being used in a study of the technical feasibility of the Qattara Project. The project would use nuclear explosives with yields ranging between about 200 and 1750 kilotons to excavate a canal about 73 km long connecting the Mediterranean Sea with the below sea-level Qattara Depression in northwestern Egypt. Computer simulations of explosive excavations were carried out at four locations near the proposed Qattara alignment. Holes were drilled in Egypt at these locations to depths of 372, 514, 632, and 701 m, respectively, to provide geophysical information needed to properly characterize each site for computer calculations. The calculated results for ground motion, particle velocity, and crater dimensions for these nuclear excavations are presented.

WEAPONRY

REFER ALSO TO CITATION(S) 14201, 14445

14144 (AD-A—067350) **The People's Republic of China and nuclear weapons: effects of China's evolving arsenal. Final report.** Washburn, T.D. (Army Military Personnel Center, Alexandria, VA (USA)). 15 Mar 1979. 110p. NTIS PC A06/MF A01.

This study attempts to present the PRC's nuclear weapon development and strategy as a rational and carefully conceived plan. Some basic foundations and objectives of Peking's nuclear policy as well as highlights of Chin's developmental methods and the current (1978) status of the PRC's nuclear weapons and nuclear weapon delivery vehicles are discussed. Aspects of the PRC's past and present strategic thinking on the employment and contorl of nuclear weapons are also mentioned. finally some conclusions and predictions for the future are offered.

14145 (EGG—1183-1757) **Research and Development FY 1979 final report.** Michael, J. (EG and G, Inc., Las Vegas, NV (USA). Energy Measurements Group). Dec 1979. Contract EY-76-C-08-1183. 124p. Dep. NTIS, PC A06/MF A01.

Separate abstracts have been prepared for individual sections. (TFD)

14146 (EGG—1183-1757, pp 11-18) **Mechano-optical transducer development.** Orrell, S.A. Dec 1979.

In Research and Development FY 1979 final report.

The application of an interferometer for reading the mechanical system of a transducer has been analyzed and some limitation identified. Results of first experimentation with single mode optical fibers are discussed, and a plan for further study is proposed.

14147 (EGG—1183-1757, pp 19-27) **Acousto-optical transient digitizer.** Doman, M.; McCrea, E.; Utiger, H. Dec 1979.

In Research and Development FY 1979 final report.

A low speed laboratory demonstration prototype of an acousto-optical (A-O modulator has been assembled from off-the-shelf components, with the exception of a neon laser light source.

14148 (EGG—1183-1757, pp 29-33) **Drilling instrumentation.** Doman, M.; McCrea, E.; Utiger, H. Dec 1979.

In Research and Development FY 1979 final report.

The purpose of this project is to investigate phenomenon related to the drilling operations and to develop instrumentation for shot-hole drilling and other drilling operations conducted at the Nevada Test Site. The immediate objective of this project is to develop a method of recording the wall profile of the large diameter shot-holes from the top of the hole to the surface of the drilling fluid. As another task, this project will investigate methods of measuring the wall profile from the surface of the drilling fluid down to the bottom of the hole. As a longer range objective, an examination of the problem relating to other types of holes will be made.

14149 (EGG—1183-1757, pp 35-39) **Thin film microelectronics.** Chearis, S.; Tarr, A. Dec 1979.

In Research and Development FY 1979 final report.

The FY 79 microelectronics thin film development project was a success. Expertise in thin film processes and fabrication advanced remarkably. The model equalizer surpassed the goal of one Gigahertz bandwidth.

14150 (EGG—1183-1757, pp 41-56) **Stripline sampler.** Jekowski, J.; Hutton, D. Dec 1979.

In Research and Development FY 1979 final report.

This newly identified R and D project is an outgrowth of work performed in the design of a multi-channel data acquisition circuit for the XKR-F demultiplexer (described elsewhere in this document). Started in the fourth quarter of FY 78, this technique has shown the promise of providing a series of rugged, low cost, high speed (1 gigasample/sec) and ultra high speed (10 gigasample/sec) transient digitizers suited for prompt diagnostic measurements at NTS. In addition, the construction of peripheral circuitry for these digitizers has also led to other useful high speed devices such as subnanosecond pulse generators and high bandwidth delay lines. Successful development of these low cost, high speed digitizers would provide practical downhole conversion of transient signals, reducing the cost of expensive compensated analog transmission systems and improving the overall accuracy and dependability of shot data.

14151 (EGG—1183-1757, pp 57-63) **XKR-F demultiplexer.** Jekowski, J.; Hutton, D. Dec 1979.

In Research and Development FY 1979 final report.

The successful implementation of low speed (less than 100 MHz) digital acquisition systems at NTS under the MIDAS program has emphasized the lack of suitable commercially available equipment that can be used for prompt diagnostics (greater than 100 MHz). Following a system study in FY 77, a R and D program goal of developing a 1 gigasample/sec, 8 bit transient digitizer was established at LAO. The report describes the effort during FY 79 to evaluate one promising technique which employs an electron beam device to demultiplex high bandwidth data.

14152 (EGG—1183-1757, pp 65-71) **Integrated optics.** Jekowski, J.; Aeby, I. Dec 1979.

In Research and Development FY 1979 final report.

The purpose of the R and D effort is to establish a baseline technology in integrated optic techniques within the EMG. Significant investment presently being made by industry in this area indicates that this technology may offer an alternative solution for high speed digital data acquisition and transmission. The objectives of this year's integrated optics program were three-fold: (1) to establish a literature search and maintain industry contacts in an attempt to make the needs of the Weapons Test Program known; (2) to assist the Las Vegas Hybrid facility in establising integrated optic fabrication techniques for their new Thin Film Laboratory; and (3) to conduct basic experiments at Los Alamos in the construction of photolithograhicaly etched plastic film devices. The report describes the successful completion of preliminary investigations into photolithographic techniques and continuing investigations into newly announced integrated optic techniques and devices that would be applicable to the weapons test program.

EXPLOSION DETECTION

REFER ALSO TO CITATION(S) 14448

14153 (UCRL—52873) **Computer modeling of the Cabriolet Event.** Kamegai, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Nov 1979. Contract W-7405-ENG-48. 35p. Dep. NTIS, PC A03/MF A01.

Computer modeling techniques are described for calculating the results of underground nuclear explosions at depths shallow enough to produce cratering. The techniques are applied to the Cabriolet Event, a well-documented nuclear excavation experiment, and the calculations give good agreement with the experimental results. It is concluded that, given data obtainable by outside observers, these modeling techniques are capable of verifying the yield and depth of underground nuclear cratering explosions, and that they could thus be useful in monitoring another country's compliance with treaty agreements on nuclear testing limitations. Several important facts emerge from the study: (1) seismic energy is produced by only a fraction of the nuclear yield, a fraction depending strongly on the depth of shot and the mechanical properties of the surrounding rock; (2) temperature of the vented gas can be predicted accurately only if good equations of state are available for the rock in the detonation zone; and (3) temperature of the vented gas is strongly dependent on the cooling effect, before venting, of mixing with melted rock in the expanding cavity and, to a lesser extent, on the cooling effect of water in the rock.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

14154 (ANL—77-65(Pt.4)) **Radiological and Environmental Research Division annual report, January-December 1977. Atmospheric physics.** (Argonne National Lab., IL (USA)). 1978. Contract W-31-109-ENG-38. 186p. Dep. NTIS, PC A09/MF A01.

Intentionally brief articles illustrate the breadth of activities. Work on the planetary boundary layer, regional-scale numerical modeling, remote probing, and surface deposition of pollutants falls under the MAP3S (Multistate Atmospheric Power Production Pollution Study). Work on air-water heat transfer and on fog formation is part of a study of the atmospheric effects of cooling ponds. Studies of dispersion characteristics in the wakes of buildings and in coastal regimes and measurements of pollutant fluxes to water surfaces are part of an investigation of potential problems associated with the siting of electricity generating stations in coastal and offshore regions.

14155 (PNL-SA—7515) **Comprehensive study of drift from mechanical draft cooling towers.** Laulainen, N.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Feb 1979. Contract EY-76-C-06-1830. 19p. (CONF-7905132—1). Dep. NTIS, PC A02/MF A01.

From Annual METER report conference; Knoxville, TN, USA (May 1979).

A comprehensive experiment to study drift from mechanical draft cooling towers was conducted. The data from this study are to be used for drift deposition model validation. Results show the effects of tower geometry and orientation with respect to the wind and to single or two tower operation. The effect of relative humidity on droplet evaporation as a function of downwind distance can also be seen.

14156 (PNL-SA—7587) **Lagrangian similarity modeling of vertical diffusion from a ground-level source.** Horst, T.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 17p. (CONF-790721—3). Dep. NTIS, PC A02/MF A01.

From 2. symposium on turbulent shear flows; London, UK (2 Jul 1979).

Several alternate Lagrangian similarity predictions of turbulent diffusion in a thermally-stratified turbulent shear flow were compared with the Prairie Grass ground-level, crosswind-integrated tracer concentration data. The best agreement with the data was found by assuming that the eddy diffusivity K of a passive contaminant corresponds to that of heat, by using an exponent r equal to 1.5 or 2 in the vertical contaminant distribution exp[-(anti z/b anti z)/sup r/], and by using Chaudhry and Meroney's equation-d anti z/dx = K(anti z)/anti zu (c anti z) for the downwind growth of the mean height anti z of the diffusing contaminant.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 13933

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 12993, 12994, 12995, 12996, 12997, 12998, 12999, 13000, 13042, 13067, 13297, 13523, 13931, 14206

14157 (BNL—26929) **Atmospheric oxidation of sulfur dioxide.** Newman, L. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract EY-76-C-02-0016. 22p. (CONF-791090—4). Dep. NTIS, PC A02/MF A01.

From Symposium on potential environmental and health effects of atmospheric sulfur deposition; Gatlinburg, TN, USA (14 Oct 1979).

An overview is presented of significant historical, recent, and new power plant and smelter plume studies which have been directed at understanding the atmospheric oxidation of sulfur dioxide. It can be concluded that the average rate of oxidation of sulfur dioxide in plumes entering into clean air is generally less than 1% per hour but in polluted urban air the rate can be at least twice as fast. In addition, there is a diurnal variation in the rate, being near zero at night and approximately 3% during midday. Although there is a tendency to select homogeneous over heterogeneous as the dominant pathway there is no basis for a definitive choice and most likely both mechanisms are at times operative. The suggestion is made that important and definitive new studies can be performed with technologies just becoming available.

14158 (BNL—27094) **Deliquescence properties and particle size change of hygroscopic aerosols.** Tang, I.N. (Brookhaven National

Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 23p. (CONF-7904123—1). Dep. NTIS, PC A02/MF A01.

From Symposium on biological studies of environmental pollutants: aerosol generation and exposure facilities; Honolulu, HI, USA (1 Apr 1979).

Ambient aerosols frequently contain large proportions of hygroscopic inorganic salts such as sulfates and nitrates, which may induce adverse health effects upon inhalation. The inhaled salt particles are invariably exposed to a humid environment; their deposition along the respiratory tract will necessarily depend upon the size change resulting from water vapor condensation. This paper discusses the deliquescent properties of pure and mixed salt aerosols and the particle size change as a function of relative humidity. Experimental results are presented for the growth of mixed chlorides (NaCl-KCl), mixed sulfates (H_2SO_4-$(NH_4)_2SO_4$), and mixed $(NH_4)_2SO_4$-NH_4NO_3 aerosol systems. It is shown that the behavior of the mixed salt aerosols in a moist atmosphere can be predicted from phase diagrams and pertinent thermodynamic properties of the bulk solutions. The evaporation of a saline droplet in an atmosphere of decreasing humidities is also investigated experimentally. For each deliquescent salt aerosol, there is a threshold humidity below which the solution droplets will quickly evaporate to become crystalline particles. The information is useful in the selection of a suitable humidification procedure to generate test aerosols for exposure studies.

14159 (CONF-7809192—) **Proceedings of the heavy lift launch vehicle tropospheric effects workshop.** (Science Applications, Inc., La Jolla, CA (USA); Argonne National Lab., IL (USA)). Dec 1979. Contract W-31-109--ENG-38. 115p. Dep. NTIS, PC A06/MF A01.

From Heavy lift launch vehicle tropospheric effects workshop; Rosemont, IL, USA (12 Sep 1978).

A workshop, sponsored by the Argonne National Laboratory, on Heavy Lift Launch Vehicle (HLLV) troposheric effects was held in Chicago, Illinois, on September 12, 13, and 14, 1978. Briefings were conducted on the latest HLLV congigurations, launch schedules, and proposed fuels. The geographical, environmental, and ecological background of three proposed launch sites were presented in brief. The sites discussed were launch pads near the Kennedy Space Center (KSC), a site in the southwestern United States near Animus, New Mexico, and an ocean site just north of the equator off the coast of Ecuador. A review of past efforts in atmospheric dynamics modeling, source term prediction, atmospheric effects, cloud rise modeling, and rainout/washout effects for the Space Shuttle tropospheric effects indicated that much of the progress made in these areas has direct applicability to the HLLV. The potential pollutants from the HLLV are different and their chymical interactions with the atmosphere are more complex, but the analytical techniques developed for the Space Shuttle can be applied, with the appropriate modification, to the HLLV. Reviews were presented of the ecological baseline monitoring being performed at KSC and the plant toxicology studies being conducted at North Carolina State. Based on the proposed launch sites, the latest HLLV configuration fuel, and launch schedule, the attendees developed a lit of possible environmental issues associated with the HLLV. In addition, a list of specific recommendations for short- and long-term research to investigate, understand, and possibly mitigate the HLLV environmental impacts was developed.

14160 (DOE/EDP—0042) **Environmental development plan for light duty diesel vehicles.** Johnson, L.R.; Monarch, M.R.; Cho, B.; Bernard, M.J. III; Kevala, R.J.; Tomlinson, J.C. (Argonne National Lab., IL (USA)). Aug 1979. Contract W-31-109-ENG-38. 111p. (ANL/CNSV-TM—26). Dep. NTIS, PC A06/MF A01.

Major public health and air quality concerns must be resolved before light-duty diesel (LDD) engine use becomes widespread. An assessment of the air quality impacts was conducted for this study on a national level for both the no-LDD and the rapid-LDD market penetration scenarios. The analysis, which includes increased vehicle stock and increased vehicle miles of travel, projects less CO, HC, NO/sub x/, and particulate emissions under both scenarios for 1985 and 1995 as compared with 1975 levels. The diesel scenario results in less CO, HC, and NO/sub x/ than the no-diesel scenario; however, the results are strongly biased toward the diesel by the existence of emission correction factors for gasoline engines. The diesel scenario, however, results in higher particulate emissions than do the no-diesel forecasts. A significant portion of the needed research identified in this plan involves in vitro experiments, short- and long-term whole animal studies, and epidemiological studies to define and quantify the health effects. These research areas should determine the health effects, including effective dose/response relationships, and make possible a comparative evaluation of similar concerns that relate to gasoline fuel combustion. Research needs also are identified in the areas of emissions control technology assessment, and the development of appropriate emission control devices for advanced diesel engines. If the health effects research reveals adverse public health impacts and if DOE and the Nation desire to keep the LDD as an energy alternative, the emission control development program must proceed at a rapid pace.Non-emissions-realated issues also are considered in this document and additional research is scheduled for odor, noise, and institutional structures affected by the proliferation of LDDs. Initial health effects research tasks have already been instituted within the Department of Energy and the Environmental Protection Agency. (JGB)

14161 (EML—365) **Submicron aerosols: a review.** Sinclair, D. (Department of Energy, New York (USA). Environmental Measurements Lab.). Nov 1979. 21p. Dep. NTIS, PC A02/MF A01.

Submicron aerosols, ranging in particle diameter from 0.1 μm to 0.001 μm, and in number concentration from 10,000 to 100,000 per cm^3, are more or less continuously suspended in the atmosphere we breathe. They usually require in situ measurement of concentration and size distribution with instruments such as diffusion batteries and condensation nucleus counters. Laboratory measurements require the development of submicron aerosol generators. The development of several of these devices and their use in the laboratory and field to measure radioactive as well as inactive aerosols is described.

14162 (LA-UR—79-3298) **High speed single particle sizing by light scattering in a flow system.** Salzman, G.C.; Hiebert, R.D.; Jett, J.H.; Bartholdi, M. (Los Alamos Scientific Lab., NM (USA); Max-Planck-Institut fuer Biophysikalische Chemie (Karl-Friedrich-Bonhoefer-Inst.), Goettingen (Germany, F.R.)). 1980. Contract W-7405-ENG-36. 6p. (CONF-800207—1). Dep. NTIS, PC A02/MF A01.

From SPIE meeting; North Hollywood, CA, USA (4 Feb 1980).

Two approaches to rapid, single particle sizing for particles in the 1 to 20 μm diameter range are presented. One method measures multiangle scattered light over a polar angular range of nearly 360 degrees. A second method is based on the analysis of the pulse shapes from small angle forward scattered light. In both cases the particles in liquid suspension are made to pass one at a time through a focused laser beam for analysis.

14163 (N—79-17433) **Air pollution. follow-up report no. 4: air pollution pilot study.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Oct 1978. 43p. NTIS, PC A03/MF A01.

The fourth follow-up on the 15 Air Pollution Pilot Study Recommendations is presented. Information for the report was collected through a questionaire prepared by the United States, as a pilot of the complete first air pollution pilot study. The plan called for annual reporting to track progress of member nations with respect to eight of the 15 recommendations. The recommendations covered in this report include general assessment of air pollution standard-setting, establishment of air quality monitoring systems and suitable systems for retrieval and storage of data, employment of recognized reference methods for monitoring, and institution of uniform procedures for conducting emissions inventories. The 15 recommendations are included in the appendix.

14164 (N—79-22654) **Ozone measurement system for NASA global air sampling program.** Tiefermann, M.W. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). May 1979. 21p. NTIS PC A02/MF A01.

The ozone measurement system used in the NASA Global Air Sampling Program is described. The system uses a commercially available ozone concentration monitor that was modified and repackaged so as to operate unattended in an aircraft environment. The modifications required for aircraft use are described along with the calibration techniques, the measurement of ozone loss in the sample lines, and the operating procedures that were developed for use in the program. Based on calibrations with JPL's 5-meter ultraviolet photometer, all previously published GASP ozone data are biased high by 9 percent. A system error analysis showed that the total system measurement random error is from 3 to 8 percent of reading (depending on the pump diaphragm material) or 3 ppbv, whichever is greater.

14165 (PB—290848) **An assessment of DOD's pollution control progress and future cost.** (General Accounting Office, Washington, DC (USA). Logistics and Communications Div.). 26 Jan 1979. 29p. NTIS, PC A03/MF A01.

The contents of this report include: legislation and policies; future pollution control costs; evaluation of pollution control reporting system; and DOD compliance with prior audit recommendations.

14166 (PB—290921) **Regional air pollution study. Point source methodology and emission inventory. Final report.** Littman, F.E. (Rockwell International Corp., Creve Couer, MO (USA). Air Monitoring Center). Jul 1978. Contract EPA-68-02-2093. 160p. NTIS, PC A08/MF A01.

The development of the point source emission data inventory for the Regional Air Pollution Study at St. Louis is discussed. To meet the unusual requirements of this study, which specified the acquisition of hourly, measured emission data for the St. Louis Air

Quality Control Region for a period of two years, a unique methodology was developed and put into practice. The result is a data base containing over 20 million pieces of information in a readily accessible form.

14167 (PB—291386) **Investigation of flow rate calibration procedures associated with the high volume method for determination of suspended particulates. Final report 1976-77.** Smith, F.; Wohlschlegel, P.S.; Rogers, R.S.C.; Mulligan, D.J. (Research Triangle Inst., Durham, NC (USA)). Aug 1978. Contract EPA-68-02-2277. 162p. NTIS, PC A08/MF A01.

Determination of total suspended particulate (TSP) in the ambient air by the high-volume method requires three independent measurements, mass of particulate collected, sampling flow rate, and sampling time. Several potential sources of error in each of the three above measurements have been identified. Implementation of technically sound, standardized flow rate calibration has long been recognized as one of the most effective means of improving the accuracy and precision of TSP data. Procedures for accomplishing this have not been standardized. The purpose of this project was to investigate potential sources of error in the flow rate calibration used in making TSP measurements using the EPA reference method. The first task was a theoretical study of the flow rate calibration and measurement techniques applicable to the high-volume sampler, and secondly to design and carry out an experimental program to assess the validity of the theoretical study concerning temperature and pressure corrections for calibration and use of the high-volume sampler. The indications from this study are that to comply with EPA's requirement that all ambient air quality data be referenced to standard conditions of 298K (25C) and 760 mm Hg and to increase the comparability of TSP data, the flow rate should be based on the flow rate of a standard volume and reported as mass/std volume, e.g., g/SCM. This procedure would require that ambient temperature and barometric pressure at the time of sample collection be known in order to calculate the flow rate based on standard volume.

14168 (PB—291442) **Inventory development for evaluation of measures for the control of nontraditional sources of particulates in southern New England. Final report.** Shives, F.G.; Kozenko, M.W. (GCA Corp., Bedford, MA (USA). GCA Technology Div.). Dec 1978. Contract EPA-68-02-2607. 104p. NTIS, PC A06/MF A01.

This report presents detailed micro-inventories of traditional and nontraditional sources of particulate matter within 5-mile and 1-mile radii, respectively, of each of 10 sites in New England. The 10 sites are located in Bridgeport, Hartford, and Waterbury, Connecticut; Boston, Fall River, Springfield, and Worcester (two sites), Massachusetts; Bangor, Maine and Providence, Rhode Island. Emissions data for traditional sources (point and area) were obtained from the most recently available state inventories for the area of concern. The data reporting format is principally that of the 'Micro-inventories for TSP' draft report (T.G. Pace, U.S. EPA, Research Triangle Park, N.C.). The results of this study can be used in an evaluation of control measures, reductions in particulate matter emissions, and likely air quality improvements at the study sites.

14169 (PB—291747) **Source assessment: noncriteria pollutant emissions (1978 update). Final report, April-July 1978.** Eimutis, E.C.; Quill, R.P.; Rinaldi, G.M. (Monsanto Research Corp., Dayton, OH (USA)). Jul 1978. Contract EPA-68-02-1874. 152p. NTIS, PC A08/MF A01.

The report lists stationary sources that emit each of 389 noncriteria pollutants. It also indicates quantities of such emissions. The list was prepared using a computerized data base established for emissions of air pollutants from approximately 800 stationary source types in the combustion, organic materials, inorganic materials, and open source categories. (A source type is defined as a group of emission sources which have the same process and emission characteristics).

14170 (PB—291764) **Source assessment: overview matrix for national criteria pollutant emissions (1978). Final report, April-July 1978.** Eimutis, E.C.; Quill, R.P.; Rinaldi, G.M. (Monsanto Research Corp., Dayton, OH (USA)). Jul 1978. Contract EPA-68-02-1874. 77p. NTIS, PC A05/MF A01.

The report alphabetically lists stationary sources that emit criteria pollutants. The overview matrix was prepared using a computerized data base established for emissions of air pollutants from approximately 800 stationary source types in the combustion, organic materials, inorganic materials, and open source categories. The matrix lists the total national emissions of criteria pollutants emitted by source type. (A source type is defined as a group of emission sources which have the same process and emission characteristics).

14171 (PB—291842) **Statistical analysis of factors influencing ozone concentrations in Southern Louisiana. Technical note.** Williamson, H.J.; Friedrich, O.M. (Radian Corp., Austin, TX (USA)). Sep 1978. Contract EPA-68-02-1383. 83p. NTIS, PC A05/MF A01.

This report describes a statistical analysis of ozone concentrations in southern Louisiana. The data which have been used were collected at nine monitoring sites during a three-month period, July 17 - October 17, in 1976. The objective of the study was to investigate the factors which accompany high levels of ozone concentration and to explain the observed relationships to as great an extent as possible. This was done to gain a better understanding of the variables which influence the amount of ozone. The relationships between ozone concentration and a number of meteorological and spatial variables have been explored. The relationships between ozone concentration and the concentrations of other pollutants are also discussed briefly.

14172 (PB—292093) **Analytical procedures for characterizing unregulated pollutant emissions from motor vehicles. Interim report, Marcy 1977—October 1978.** Dietzmann, H.E.; Smith, L.R.; Parness, M.A.; Fanick, E.R. (Southwest Research Inst., San Antonio, TX (USA)). Feb 1979. Contract EPA-68-02-2497. 497p. NTIS, PC A21/MF A01.

Analytical procedures are described that may be used to assess motor vehicle emission rates of several unregulated pollutants including aldehydes, organic amines, sulfur dioxide, nitrous oxide, several individual hydrocarbons including benzene, hydrogen sulfide, total cyanide, organic sulfides, nickel carbonyl, ammonia, sulfate, and N-nitrosodimethylamine (sampling conditions only). A series of validation experiments involving motor vehicle exhaust with injects of known quantities of the compounds of interest and the Constant Volume Sampling system commonly used in emissions certification are described for several of the analytical procedures. The Clean Air Act as amended August 1977 requires in section 202(a) 4 that unregulated pollutants emitted from motor vehicles be measured to assure that no unreasonable risk to public health and welfare exists.

14173 (PB—292242) **Cost and economic impact assessment for alternative levels of the national ambient air quality standards for ozone. Final report.** Lloyd, K.H. (Environmental Protection Agency, Research Triangle Park, NC (USA)). Feb 1979. 143p. NTIS, PC A07/MF A01.

This report presents the results of an analysis of the potential impact of feasible changes in the national ambient air quality standard for ozone on national costs of control and the attainment status for various areas of the country. An assessment is made for 90 AQCRs of the control requirements for alternative levels of the standard. For each AQCR this analysis estimates the potential emissions in 1987 and the allowable emissions for attainment of the standard levels. Next, the analysis estimates the potential emission reduction achievable with the Federal Mobile Vehicle Control Program (FMVCP), new and modified source control, application of reasonably available control technology (RACT) on existing stationary sources and further motor vehicle controls through inspection/maintenance programs and transportation control plans. Based on the projected emission reductions, control costs are estimated for applying technology in an attempt to attain alternative standard levels. While the analysis considers each AQCR separately, the results are presented in aggregate form for all 90 AQCRs instead of each individual AQCR. The analysis does not include a rigorous economic impact assessment on the numerous affected industries or the impact of growth restrictions on the economies of affected urbanized areas. A summary of the impact on several industries for which EPA has conducted economic impact studies is presented.

14174 (PB—292249) **Workbook for comparison of air quality models.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). May 1978. 113p. NTIS, PC A06/MF A01.

The workbook describes a technique for the qualitative comparison of modeling approaches on technical grounds. The methodology is based upon an applications approach. The results of the model comparison depend upon the application for which the model is to be used as well as upon the model characteristics. In each application of the technique, the model of interest is compared with a reference model. Any model may be specified as the reference model, as long as it is compatible with the application of interest.

14175 (PB—292252) **National emissions report (1974): National Emissions Data System of the Aerometric and Emissions Reporting System. Annual report.** (Environmental Protection Agency, Research Triangle Park, NC (USA)). Jul 1978. 439p. NTIS, PC A19/MF A01.

The National Emissions Report summarizes annual cumulative estimates of source emissions of five criteria pollutants: particulates, sulfur oxides, nitrogen oxides, hydrocarbons, and carbon monoxide. Source emissions data are reported to the U.S. Environmental Protection Agency under provisions of Section 110 of the Clean Air Act, as amended 1977, and EPA Regulations, Title 40, Code of Federal Regulations, Part 51.7. Summary data are presented for the nation as a whole, for individual states, and for Air Quality Control Regions and individual interstate portions, thereof. The data compilations result from the operations of the National Emissions Data System (NEDS), which functions as a component of the comprehen-

sive EPA air information system--the Aerometric and Emissions Reporting System (AEROS). AEROS is managed by the National Air Data Branch, Monitoring and Data Analysis Division, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, at Research Triangle Park, North Carolina 27711.

14176 (PB—292271) **Guideline for the interpretation of ozone air quality standards.** Curran, T.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jan 1979. 41p. NTIS, PC A03/MF A01.

This document discusses the interpretation of the National Ambient Air Quality Standards (NAAQS) for ozone that were promulgated by the U.S. Environmental Protection Agency in 1979. These standards differ from previous NAAQS in that attainment decisions are based upon the expected number of days per year above the level of the standard. The data analysis implications of this statistical formulation of an air quality standard are presented for both compliance assessment and design value estimation purposes. Example calculations are included.

14177 (PB—292489) **Analysis of ensemble averaged concentrations and fluxes in a tracer puff. Final report.** Hutcheson, M.R. (Oklahoma Univ., Norman (USA). School of Meteorology). Jan 1979. 113p. NTIS, PC A06/MF A01.

Ensemble averaged fluxes and concentrations in a tracer puff diffusing in the atmospheric surface layer were analyzed. The analysis used radiation data published by the Battelle Memorial Institute. Fluxes that satisfy the diffusion equation for a Gaussian puff with an arbitrary diffusion rate were obtained from the gradient transfer hypothesis, using the proper diffusivities. These fluxes were used as estimates of the ensemble averaged fluxes in the surface layer. The radiation data, however, were too sparse to use alone in analyzing the tracer concentrations. Therefore, the data were combined with a modified Gaussian distribution in a variational technique to obtain concentration values. Since the ensemble averaged concentration distribution was more nearly normal than the distribution in an individual puff, the concentration estimates were obtained from a model using a Gaussian distribution in the horizontal, which constrained the estimates as close to the analyzed concentrations as possible. The concentration and flux estimates were combined with the diffusion equation in a variational technique. The analyzed fluxes and concentrations obtained were close to the estimates and satisfied the diffusion equation. The values are assumed to be the true ensemble averaged concentrations and fluxes for the puffs examined.

14178 (PB—293352) **Rancho Seco building wake effects on atmospheric diffusion.** Start, G.E.; Cate, J.H.; Dickson, C.R.; Ricks, N.R.; Ackerman, G.R. (National Oceanic and Atmospheric Administration, Idaho Falls, ID (USA). Environmental Research Labs.). Dec 1978. Contract AT(49-25)-1004. 189p. NTIS, PC A09/MF A01.

A series of 23 paired gaseous tracer releases at the Rancho Seco Nuclear Power Station in 1975 was the third of several tests designed to investigate the diffusion characteristics of the atmosphere under conditions of low windspeed and temperature inversion. This test also evaluated the effects of flow around buildings upon dilution of pollutants. Gaseous tracers were laterally dispersed about six times more than the expected amounts from Pasquill-Gifford curves of sigma-y. Most of this increase could be related to observed variance of the horizontal wind direction (meandering). For ground-level releases the effective sigma-z values were 16 times greater than the corresponding values from the Pasquill-Gifford curves. Measured ground-level azial concentrations were about 75 times smaller than predicted by the Gaussian diffusion equation for a ground-level release when Pasquill-Gifford values of sigma-y and sigma-z were used. Systematic building wake cavity circulations distributed near ground-level released tracers and oil fog vertically throughout the zone in the lee of the containment and auxiliary buildings. This vertical flux of material redistributed material so that the plume mass occurred at a greater height than expected for the height of release. Data representing the findings of this test series are presented in appendices.

14179 (PB—294838) **Sources and transport of trace metals in urban aerosols. Final report apr 73-jan 76.** Winchester, J.W.; Nelson, J.W. (Florida State Univ., Tallahassee (USA). Dept. of Oceanography). Mar 1979. 77p. NTIS PC A05/MF A01.

A methodology was developed, tested, and applied to the identification of trace element aerosol sources and trace element aerosol transport phenomena. The method uses light weight and portable field sampling equipment, and results in the acquisition of large data sets suitable for statistical analysis and the testing of aerosol transport models. Aerosol sampling in the ambient atmosphere was accomplished through a combination of time-sequenced filter collections with hourly resolution, and fractionated aerosol collections with 0.25 micrometer resolution. Elemental analysis was performed with particle induced X-ray emission, a sensitive and rapid method. Aerosol characterization studies were focussed on St. Louis, Missouri, during the Regional Air Pollution Study. Trace element pollutants were distinguished from their natural components on the basis of particle size distributions. Statistical analysis of time-sequenced concentration measurements revealed four distinct pollution sources for lead. A related analysis demonstrated that meteorological factors controlling the transport of titanium aerosol across the city could be identified. Extensions of the meteorology were applied to (1) the determination of trace element pollution deposition in the human respiratory tract through direct sampling of exhaled breath, (2) indoor environments, and (3) nonurban continental and marine atmospheres.

14180 (PB—294982) **High volume and gas bubbler sampler preparation, installation, and audit procedures.** Logsdon, J.; Kocal, W. (Environmental Protection Agency, Chicago, IL (USA). Region V). Sep 1975. 54p. NTIS PC A04/MF A01.

This document describes the operations required of the Environmental Protection Agency, (EPA) Personnel for set-up, calibration and maintence of Regional Air Quality Assurance Network, (RAQAN) particulate and bubbler samplers.

14181 (PB—294997) **Polymeric interfaces for stack monitoring. Final report, January 1973-June 1976.** Felder, R.M.; Ferrell, J.K. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). Nov 1978. 186p. NTIS PC A09/MF A01.

Research has been performed on the use of polymeric interfaces for in situ continuous stack monitoring of gaseous pollutants. Permeabilities of candidate interface materials to SO2 were measured at temperatures from ambient to 200C, and the results were used to design interfaces for field tests. A portable field monitoring system was constructed and used to carry out SO2 monitoring runs in two SO3 absorption tower stacks, and in oil-fired and coal-fired power plant boiler stacks. The results were in excellent agreement with data obtained by standard wet chemical methods. The SO2 concentrations in the sample gases varied linearly with the concentrations in the stack; water vapor, acid mist, and particulates in the stack gases had no effect on the interface performance; and fluctuations in the stack SO2 concentration were mirrored rapidly and accurately in the measured responses. The results suggest the potential value of in-situ polymeric interfaces for continous monitoring in stack environments too dirty or corrosive for conventional devices to be used.

14182 (PB—295000-SET/SL) **Flue gas desulfurization pilot study. Phase I. Survey of major installations.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society). Jan 1979. 842-in 13vp. NTIS PC E19.

No abstract available.

14183 (PB—295055) **Evaluation of particulate mass monitors using the beta gauge technique. Final report, June 1973-February 1975.** Jackson, M.R. (Particle Data Labs. Ltd., Elmhurst, IL (USA)). Apr 1979. Contract EPA-68-02-1216. 73p. NTIS PC A04/MF A01.

A field study was conducted to evaluate two commercially available beta gauge instruments for measuring particulate mass concentrations in stationary source emissions. Performance of the instruments was compared with a manual method of measurement at a ferrite rotary-kiln calciner, at a slurry cement kiln with an electrostatic precipitator, and at an oil-fired boiler. Tests were conducted over a 168-hour period to establish instrument accuracy, calibration error, drift and system reliability. Descriptions of the instruments, test programs and test sites are presented together with a detailed summary of the experimental data. The accuracy of the beta gauge instruments was strongly dependent upon the sampling characteristics of the extractive probes. The instruments tested were not capable of correctly measuring the particulate concentration in the stack, nor of operating continuously for a 168-hour period. In the case of the cement kiln, the particle concentration measured by the beta gauge instruments correlated well with the concentration determined from the filter catch portion of the manual method, but not with the fiber plus probe catch. Particle deposition in the probe of the beta instruments was as high as 86% (average) for the cement plant emissions.

14184 (PB—295725) **Regional transportation improvement program, emissions analysis methodology, fiscal year 1980.** McFarlane, N.; Shijo, W. (Southern California Association of Governments, Los Angeles (USA)). Apr 1979. 78p. NTIS PC A05/MF A01.

This report documents the methodology used by the Southern California Association of Governments (SCAG) to perform a mobile-source emissions analysis of the Regional Transportation Improvement Program (RTIP). The geographical area of analysis was Ventura County and the California South Coast Air Basin, which includes all of Orange County, and portions of Los Angeles, Riverside, and San Bernardino Counties. The analysis, required by Federal Transportation -- Air Quality Planning Guidelines as well as California State TIP guidelines, used a variety of modeling techniques and calculations to analyze measures including, but not limited to, new freeway construction, freeway widening, and computerized traffic control. Emphasis was placed on arriving at methods that were simple, inexpensive, and quick since the analysis was con-

strained by a lack of extensive data, funding, and time. The analysis concludes that the RTIP measures should be justified by traditional transportation reasons (congestion relief, capacity improvement, etc.) rather than air quality reasons. However, the analysis did show that the RTIP will result in a small beneficial impact on air quality.

14185 (PB—296135) **Kraft pulping - control of trs emissions from existing mills.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Mar 1979. 212p. NTIS PC A10/MF A01.

Guidelines to aid the State in their preparation of plans for the control of emissions of total reduced sulfur (TRS) from existing kraft pulp mills are being published under the authority of section 111(d) of the Clean Air Act. TRS emissions from kraft pulp mills are extremely odorous, and there are numerous instances of poorly controlled mills creating public odor problems. Adoption of these emission guidelines by the States would result in an overall reduction of about 80 percent in nationwide TRS emissions from kraft pulp mills.

14186 (PB—296137) **Fugitive dust emission study for the city of Albuquerque. Final report.** Wilson, A.L. (Engineering-Science, Inc., Arcadia, CA (USA)). Feb 1979. Contract EPA-68-02-2537. 29p. NTIS PC A03/MF A01.

This study involved an emission inventory for fugitive dust sources in Albuquerque, New Mexico. Areas with a one mile radius were inventoried for five non-attaining particulate monitoring sites, with each site the center of the circle. Emissions from point sources within these areas were also included. Fugitive dust from unpaved roads and re-entrained dust from paved roads were the two primary contributors to air quality violations. The Air Quality Display Model (AQDM) was used to predict particulate concentrations and calculate the relative contribution of each point and area source.

14187 (PB—297310) **Regional ai540 pollution study. dichotomous aerosol sampling system. Final report.** Nelson, E. (Rockwell International Corp., Creve Couer, MO (USA). Air Monitoring Center). Apr 1979. Contract EPA-68-02-2093. 50p. NTIS, PC A03/MF A01.

Ten of twenty-five stations making up the Regional Air Monitoring System (RAMS) in St. Louis were equipped with dichotomous samplers and high volume filter samplers for aerosol measurements. The dichotomous samplers were designed for automatic operation and were capable of collecting up to 36 samples in each of two size fractions before filter stacks must be changed. Sample filters were pre-weighed by beta gauging before exposure in St. Louis and subsequently returned to LBL for determination of aerosol mass in each size fraction, as well as determination by x-ray fluorescence of the concentrations of the following elements: A, Si, P, C, K, Cr, Mn, Ga, Rb, Sr, Sn, Sb, Ba, Hg, S, Ca, Ti, V, Fe, Ni, Co, Zn, As, Se, Br, Cd, and Pb. Approximately 33,000 samples were collected between March 1975 and March 1977. The operation of the samplers in the RAMS network is described along with problems encountered and procedures used for preventive maintenance and quality control. Also described are two streaker samplers specially installed for continuous aerosol measurements and a silicon cell pyranometer.

14188 (PB—297393) **Effect of diethylhydroxylamine on smog chamber irradiations. Final report.** Cupitt, L.T.; Corse, E.W. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Apr 1979. Contract EPA-68-02-2566. 101p. NTIS, PC A06/MF A01.

The addition of diethylhydroxylamine (DEHA) to the urban atmosphere had been suggested as a means of preventing photochemical smog. Smog chamber studies were carried out to investigate the photochemical smog formation characteristics of irradiated hydrocarbon-nitrogen oxides - DEHA mixtures. Propylene and n-butane were the hydrocarbons used. The effects of DEHA upon ozone formation, aerosol formation, peroxyacetyl nitrate formation, nitric oxide-to-NOx conversion, and hydrocarbon consumed are described. The rate constant for the reaction DEHA + OH yields to products was estimated as 4.1 + or - 3.4 X 10 to the 5th power/ppm/min. Possible reaction schemes for DEHA in the photochemical smog mechanism are discussed. The addition of DEHA to a HC/NOx system inhibits the conversion of NO to NO2 during the initial minutes of irradiation, but after continued irradiation accelerates this conversion.

14189 (PB—297576) **Regional air pollution study, quality assurance audits. Final report.** Klein, O.; Littman, F. (Rockwell International Corp., Creve Couer, MO (USA). Air Monitoring Center). May 1979. Contract EPA-68-02-2093. 135p. NTIS, PC A07/MF A01.

RAPS Quality Assurance audits were conducted under this Task Order in continuation of the audit program previously conducted under Task Order No. 58. Quantitative field audits were conducted of the Regional Air Monitoring System (RAMS) Air Monitoring Stations, Local Air Monitoring Stations (State of Illinois, St. Louis City, and St. Louis County), RAPS helicopters and various measurement systems employed in the RAPS intensive studies. Audit results are reported for systems measuring NO, NOx, O3, SO2, total sulfur, total hydrocarbons, CH4 and CO. An investigation was conducted on the effect of Teflon particulate filters on NO, NO2, O3, and SO2 concentrations in sampled air. Measured sample losses are reported for synthetic pollutant - air mixtures sampled through new and used filters under both dry and humid conditions. The investigation also revealed effects of humidity on the response of analyzers to the various pollutants. The accuracy of SO2 calibration mixtures prepared with the commercial dynamic calibration system employed in the audits was investigated. As a result of this investigation and experience gained during the audits, the calibration system was modified to improve performance under field conditions.

14190 (PNL-SA—7549) **Terrain effects on atmospheric transport and dispersion: a status report.** Orgill, M.M. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1979. Contract EY-76-C-06-1830. 22p. (CONF-790777—1). Dep. NTIS, PC A02/MF A01.

From 5. international conference on wind engineering; Fort Collins, CO, USA (8 Jul 1979).

Future air quality assessment methods need accurate information for describing atmospheric transport and dispersion in complex landforms. A status report is given of the problem of transport and dispersion in complex terrain and evaluates the research methods and needs that are required for realistic solutions to the problem. A current multilaboratory complex terrain study at the Geysers geothermal resource area is developing methods and models to address the many aspects of dispersion in complex landforms. Initial results from this study are presented and discussed.

14191 (UCD—472-125, pp 9-16) **Collection and handling of samples of aerosols produced in coal utilization for evaluation of biomedically relevant properties.** Raabe, O.G. Oct 1979.

In Annual report, 1978-1979.

Releases of airborne toxicants may occur at various stages of coal combustion and conversion technologies. These will usually be complex mixtures of both organic and inorganic aerosols and vapors that need to be studied and evaluated in the perspective of the potential biological fate and effects if inhaled. During collection, handling, and evaluation of samples, extreme care based on careful planning is needed to insure representativeness, stability, and cleanliness, and to prevent the introduction of artifacts. Emphasis is on biological testing as an important application of these samples.

14192 (UCD—472-125, pp 17-19) **Quantification of the surface concentration of cadmium in fly ash.** Silberman, D.; Fisher, G.L. Oct 1979.

In Annual report, 1978-1979.

To evaluate further elemental distribution within fly ash particles detailed fractional solubility studies were performed. This report specifically describes efforts to quantify the relative surface and matrix distributions of cadmium. Approximately 60% of the cadmium in fly ash appears to be surface-associated.

14193 (UCD—472-125, pp 20-21) **Elemental analysis of individual morphological particle classes in coal fly ash.** Fisher, G.L.; Hayes, T.L.; Lai, C.; Prentice, B.A. Oct 1979.

In Annual report, 1978-1979.

Cooperative studies with Donner Laboratory, UC Berkeley, have demonstrated the matrix heterogeneity of individual fly ash particels. Studies are under way to quantify the elemental composition of light-microscopically determined particle morphologies. This research will also provide insight into the mechanism of fine particle formation and potential toxicity associated with unique particulate compositions.

14194 (UCD—472-125, pp 26-32) **Comparison of fractionated electrostatic-precipitator hopper ash and stack-collected size-classified fly ash.** Fisher, G.L.; Raabe, O.G.; Prentice, B.A.; Silberman, D. Oct 1979.

In Annual report, 1978-1979.

In an effort to define the health hazards from coal combustion fly ash, two sampling methods were compared for analyzing particle size and chemical composition as well as morphological characteristics of the aerosols. Relatively good agreement was obtained. (PCS)

14195 (UCD—472-125, pp 33-39) **Sample collection of emissions and effluents from industrial coke ovens.** Kimble, B.J.; Fisher, G.L.; Chrisp, C.E.; Jennings, W.L.; Lammert, J.E.; Raabe, O.G.; Teague, S.V. Oct 1979.

In Annual report, 1978-1979.

Equipment has been designed and constructed for the collection of potentially toxic emissions from an industrial coking plant. Gaseous and particulate samples as well as coal, coal tars and oils were collected from various locations around a commercial coke oven and its associated by-products area. Chemical characterization studies and biological testing using the Ames mutagenicity assay are currently in progress.

14196 (UCRL—52861) **Potential environmental effects of aircraft emissions.** Luther, F.M.; Chang, J.S.; Duewer, W.H.; Penner,

J.E.; Tarp, R.L.; Wuebbles, D.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1979. Contract W-7405-ENG-48. 233p. Dep. NTIS, PC A11/MF A01.

An assessment is provided of the potential environmental effects of fleets of subsonic, supersonic, and hypersonic aircraft. A general discussion of photochemical and transport modeling techniques is included along with a description of the LLL one-dimensional transport-kinetics model that was used in the assessment. Model simulations of the natural and perturbed stratosphere are used to compare theory with observations as a means of verification of model processes. A review is provided of engine emission indexes and 1990 fleet projections. Assessments of the potential effects of subsonic and supersonic aircraft fleets indicate a small increase in total ozone. However, the change in total ozone is the net difference between regions of ozone increase (in the lower stratosphere and upper troposphere) and ozone decrease (in the upper stratosphere). The percent change in the local ozone concentration is much larger than the change in total ozone. The effect of a proposed hydrogen fueled hypersonic transport fleet is a small reduction in total ozone. A study is made of the effect on these results of uncertainties in chemical rate coefficients, speculative chemical reactions, temperature feedback, hydrostatic adjustment, and various model parameters. The potential effect on ozone of aircraft emissions is compared with potential changes due to other anthropogenic perturbations.

14197 Model of the effects of stack and inversion heights on the transport and diffusion of pollutants in the planetary boundary layer. Kao, S.K.; Yeh, E.N. (Univ of Utah, Salt Lake City). *Atmos. Environ.;* **13**: No. 6, 873-878(1979).

The effects of the stack height and thermal stratification on the transport and diffusion of pollutants are analyzed in a planetary boundary layer in which the fields of mean motion and temperature are horizontally homogeneous, and the Reynolds terms are assumed to be proportional to the vertical gradient of the mean quantities. Time dependent equations of diffusion, motion and thermodynamics are analyzed wilth appropriate initial and boundary conditions at the surface and the inversion height. 16 refs.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 13182, 13997, 13998, 14161, 14229

14198 (AECL—6319) **Bibliography of AECL publications on environmental research.** Hawley, N.J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Dec 1978. 40p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Publications in the open literature on environmental research performed by AECL personnel are listed chronologically with the first entry dated 1951. It is intended that the bibliography should be brought up to date yearly.

14199 (COO—4364-2) **Environmental consequences of atmospherеic krypton-85. Final report, January 1, 1977-September 30, 1979.** Boeck, W.L. (Niagara Univ., NY (USA)). 1979. Contract EE-77-S-02-4364. 17p. Dep. NTIS, PC A02/MF A01.

Krypton-85 is a radioactive inert gas produced during normal operations of the nuclear fuel cycle. The quantities of krypton-85, that will be produced in the next century, are sufficient, if released, to alter the electrical state of the atmosphere. The principal hypothesis is that an anthropogenic alteration of the electric state of the atmosphere could alter other meterological phenomena and lead to significant environmental impacts. The goal of this project was to explore some areas of basic science related to the evaluation of that hypothesis. The approach was primarily theoretical. The following topics were addressed: a first approximation model to estimate the effects of krypton-85 on the electrical state of the atmosphere; an analysis of the pathways between krypton-85 production and the atmosphere; an analytical model for fair weather atmospheric electricity; and a dipole model for atmospheric electricity. The results will provide a framework on which detailed models can be built. The results should provide better understanding of some topics in atmospheric electricity.

14200 (EMSL-LV—0539-31) **Off-site environmental monitoring report for the Nevada Test Site and other test areas used for underground test areas used for underground nuclear detonations, January-December 1978.** Grossman, R.F. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Oct 1979. Contract EY-76-A-08-0539. 147p. Dep. NTIS, PC A07/MF A01.

Under Memorandum of Understanding No. EY-76-A-08-0539 with the US Department of Energy (DOE), the US Environmental Protection Agency (EPA), Environmental Monitoring and Support Laboratory-Las Vegas (EMSL-LV), continued its Off-Site Radiological Safety Program within the environment surrounding the Nevada Test Site (NTS) and at other sites designated by the DOE during calendar year 1978. This report, prepared in accordance with the DOE Manual, Chapter 0513, contains summaries of the EMSL-LV dosimetry and sampling methods and analytical procedures, and the analytical results from environmental samples collected in support of the DOE nuclear testing activities. Where applicable, dosimetry and sampling data are compared to appropriate guides for external and internal exposures of humans to ionizing radiation. In addition, a brief summary of pertinent, and demographical, features of the NTS and the NTS environs is presented for background information.

14201 (PB—290994) **Levels and disTribution of environmental plutonium around the trinity site. Technical note (final).** Douglas, R.L. (Environmental Protection Agency, Las Vegas, NV (USA). Office of Radiation Programs). Oct 1978. 56p. NTIS, PC A04/MF A01.

A study was conducted in central New Mexico to evaluate the levels and distribution of plutonium resulting from the detonation of the Trinity device in 1945. A total of 88 soil samples were collected, covering an area of roughly 4500 square miles. Air samples were collected during 1975 at a location within the Trinity fallout pattern, and at another site outside the pattern. All samples were analyzed for plutonium-239,240 by alpha spectroscopy, and some were analyzed by mass spectroscopy for both nuclides. Trinity plutonium can be distinguished from global fallout plutonium by the ratio of the two plutonium nuclides. The results indicate that most of the area sampled contains detectable amounts of Trinity plutonium in the surface 5 cm of soil. The highest levels of plutonium-239,240 deposition in soil (in unrestricted areas) were on the order of 90 nCi/m2. The air samples at the site within the fallout pattern contained about 50 percent Trinity plutonium, but the average concentration of airborne plutonium at the two locations was the same.

14202 (PNL—2850(Pt.4), pp 2.41-2.42) **Real-time measurement of Pu in air at below-MPC levels.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

A direct-inlet mass spectrometer is being developed for monitoring low-level airborne plutonium on a real-time basis. The instrument will be capable of measuring plutonium concentrations below the maximum permissible concentration (MPC) level. Modifications to the instrument have reduced hydrocarbon background. A technique for electropolishing the bore of the direct-inlet capillary tube has been developed. Particle bouncing from the ionizing filament has been encountered while calibrating the instrument to provide particle size information.

14203 (STI/PUB—482) **Monitoring of airborne and liquid radioactive releases from nuclear facilities to the environment. Safety series No. 46: recommendations.** (International Atomic Energy Agency, Vienna (Austria)). 1978. 133p. IAEA.

This manual defines the objectives of effluent monitoring programmes, and to provide guidance on the design of adequate systems and on the choice of appropriate monitoring methods and instruments for different types of nuclear fuel cycle facilities. Examples of the methods and equipment used for measuring radioactive airborne and liquid releases and of comprehensive monitoring programmes and requirements, provided by members of the Advisory Group, are included in the manual as annexes to the main text.

14204 Annual-average effect of the deposition-resuspension process on airborne contamination near the surface. Horst, T.W. (Battelle, Pacif Northwest Lab, Richland, Wash). *Atmos. Environ.;* **13**: No. 6, 791-796(1979).

Computational simulation of the diffusion-deposition-resuspension process has shown that the net effect of deposition and resuspension is, in general, a reduction in the annual-average ground-level airborne contamination. Thus an upper limit to the annual-average ground-level contamination can be calculated by ignoring both processes. This net reduction is found to be a direct consequence of the climatological mix of wind speeds and atmospheric stabilities; the contaminant is preferentially deposited during periods of limited vertical mixing and high ground-level airborne contamination and is resuspended during periods of greater average mixing and lower ground-level contamination. 5 refs.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 13780, 14232

REGULATIONS

REFER ALSO TO CITATION(S) 14173, 14176

14205 (PB—291645) **Characterization of vehicle use in fine air quality control regions.** Eldon, J.A.; Hunsaker, D.B. (Technology Service Corp., Santa Monica, CA (USA)). 30 Mar 1978. Contract EPA-68-03-2392. 94p. NTIS, PC A05/MF A01.

Under contract to the Emission Control Technology Division of the U.S. Environmental Protection Agency, Technical Service Corporation (TSC) has compiled data, estimates and projections of vehicle population and use by vehicle age and type, for each of these cities: Chicago, Denver, Los Angeles, Houston, and Phoenix. As motor vehicle emissions are sensitive to temperature, humidity, and barometric pressure, meteorological data were also compiled.

14206 (PB—292568) **Air pollution control in California - 1976.** (California State Air Resources Board, Sacramento (USA)). 1976. 41p. NTIS, PC A03/MF A01.

The contents of this report are listed as follows: summary; air pollution control agencies in California; overview of air pollution; major pollutants; air quality profile of California; air quality trends; controlling automotive pollution; controlling pollution from stationary sources; enforcement activities of the ARB (Air Resources Board); resolving local air pollution problems; ARB research; and legislation.

14207 (PB—294963) **Directory of air quality monitoring sites active in 1977. Annual report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Monitoring and Data Analysis Div.). Nov 1978. 780p. NTIS PC A99/MF A01.

This publication includes a listing of all monitoring sites active in 1977 which have submitted SAROAD Site Identification Form. Each Site to be classified as operational and listed in this directory must have sampled at least one pollutant in 1977. In addition to the site listing, this document reflects useful information on the pollutant sampled.

14208 (PB—294971) **Projected 1982 carbon monoxide levels in the non-attainment areas of New Mexico. Final report.** (Engineering-Science, Inc., Arcadia, CA (USA)). Oct 1978. Contract EPA-68-02-2537. 33p. NTIS PC A03/MF A01.

Emission inventories for carbon monoxide in years 1977 and 1982 are provided for nonattainment areas in Farmington, Las Cruces, and Santa Fe. Carbon monoxide emissions for 1977 are provided for the Albuquerque metropolitan area. Carbon monoxide levels for the Farmington, Las Cruces, and Santa Fe nonattainment areas were estimated for 1982 using proportional rollback. Results indicate that air quality standards will be attained by 1982 from application of the Federal Motor Vehicle Control Program.

14209 (PB—294975) **Summary of Group I control technique guideline documents for control of volatile organic emissions from existing stationary sources.** Peterson, P.R.; Sakaida, R.R. (Pacific Environmental Services, Inc., Santa Monica, CA (USA)). Dec 1978. Contract EPA-68-02-2606. 42p. NTIS PC A03/MF A01.

Control Technique Guideline (CTG) documents have been prepared by the Office of Air Quality Planning and Standards of the U.S. EPA to assist the states in defining reasonably available control technology (RACT) for the control of volatile organic compound emissions from existing stationary sources. This document summarizes those CTGs issued as of January 1978 including a design criteria document for gasoline service stations. A description of each source category is provided, along with RACT and costs to retrofit a model facility. Source categories included are: surface coating of cans, metal coils, fabric, paper products, automobile and light duty trucks, metal furniture, magnet wire, and large appliances; gasoline terminals, bulk plants and service stations; fixed roof petroleum storage tanks; miscellaneous refinery sources; cutback asphalt; and solvent metal cleaning (degreasing).

14210 (PB—294976) **Volatile organic compound control strategy for non-attainment areas in Louisiana. Final report.** Dadiani, J.; Petersen, C.W.; Raubacher, T.J. (TRW Environmental Engineering Div., Vienna, VA (USA)). Dec 1978. Contract EPA-68-02-2541. 68p. NTIS PC A04/MF A01.

The control strategies described in this report are intended to reduce the amount of volatile organic compounds emitted in the New Orleans, Baton Rouge, and Shreveport metropolitan areas in Louisiana. The oxidant air quality design values used for the control strategy development are .15 ppm, .19 ppm, and .14 ppm for New Orleans, Baton Rouge, and Shreveport respectively. Linear rollback and modified rollback were used to calculate the required reductions. Five ozone transport scenarios were considered in calculating emissions reductions necessary to attain standards. Emissions for 1977 were projected to 1982 and reductions were taken for application of RACT to stationary point sources plus the Federal Motor Vehicle Control Program. A demonstration of attainment of standards was not possible with any scenario in Baton Rouge and Shreveport. Attainment could be demonstrated in New Orleans with original (T(o)) and future (T(f)) transport values of .12 ppm and .02 ppm respectively.

14211 (PB—294977) **Volatile organic compound emission inventory for non-attainment areas in Louisiana. Final report.** Dadiani, J.; Nunn, A.B. III; Raubacher, T.J. (TRW Environmental Engineering Div., Vienna, VA (USA)). Dec 1978. Contract EPA-68-02-2613. 139p. NTIS PC A07/MF A01.

This project includes the development of a volatile organic compound emission inventory for 17 non-attainment parishes in Air Quality Control Region (AQCR) 106 and 2 non-attainment parishes in AQCR 022. The New Orleans and Baton Rouge metropolitan areas are located in AQCR 106 and the Shreveport metropolitan area is located in AQCR 022. The inventories were compiled in accordance with the methodology described in Procedures for the Preparation of Emission Inventories for Volatile Organic Compounds. The inventories consist of emissions from stationary point sources, stationary area sources, and mobile sources. Stationary point sources account most of the emissions in the Baton Rouge area. Emissions are more evenly distributed between the three categories in the New Orleans area, and mobile source emissions are predominant in the Shreveport area. The volatile organic compound emission inventory represents calendar year 1977.

14212 (PB—294979) **Summary report on motor vehicle emissions inspection and maintenance programs for non-attainment areas in Louisiana. Final report.** Dadiani, J.; Raubacher, T.J. (TRW Environmental Engineering Div., Vienna, VA (USA)). Feb 1979. Contract EPA-68-02-2541. 42p. NTIS PC A03/MF A01.

The report documents general information on motor vehicle inspection and maintenance (I/M) with respect to the metropolitan areas of New Orleans, Baton Rouge, and Shreveport. A background discussion of events leading to the need for an I/M program is provided. A general description of I/M is provided with respect to types of programs, the benefits of I/M, and information on implementation activities. Expected hydrocarbon emission reductions are included.

14213 (PB—294983) **Voc (volatile organic compounds) emissions reduction study for oxidant attainment in Massachusetts, Rhode Island, and Connecticut. Final report.** Drivas, P.J.; Gordon, R.J.; Wilson, K. (Pacific Environmental Services, Inc., Santa Monica, CA (USA)). Mar 1979. Contract EPA-68-02-2606. 60p. NTIS PC A04/MF A01.

A review was conducted of available models which relate ozone concentrations to VOC and NOx emissions. The city-specific version of the Empirical Kinetic Modeling Approach (EKMA) was recommended as the most appropriate model for New England with reasonable input and computer requirements. This model was applied to Bridgeport-New Haven, CT; Providence, RI; Boston, MA; Springfield, MA; and Worcester, MA to compute VOC emission reductions necessary to achieve current and future Federal Oxidant Standards. The ozone design values and transported ozone values were selected to reflect the maximum requirement for VOC emission reduction. All no. 3 monitoring data for Massachusetts, Connecticut and Rhode Island were adjusted to a common basis by taking into account EPA calibration audits and changes in calibration procedures.

14214 (PB—296156) **Economic impact of incorporating RACT I guidelines for VOC emissions into the Illinois air pollution control regulations, R78-3 and R78-4. Final report.** Yates, J.J.; Chaudhry, R.K.; Kuhaneck, D.P.; Kleinrath, A.; Hallenbeck, W.H. (ETA Engineering, Inc., Westmont, IL (USA)). Apr 1979. 288p. NTIS PC A13/MF A01.

In order to reduce ambient ozone concentration and achieve the NAAQS, the U.S. Environmental Protection Agency has developed guidelines from the control of volatile organic compounds (VOC) emissions from stationary sources. These guidelines reflect EPA's judgment of what constitutes reasonably available control technology (RACT). The RACT guidelines were developed to aid states in revising their state implementation plans to achieve the NAAQS. The proposed revisions to the Illinois Air Pollution Control Regulations, R78-3 and R78-4, incoporate those RACT categories for which guidelines were published before January 1, 1978.

14215 (PB—297288) **Economic impact of implementing RACT guidelines in the State of Tennessee. Final report.** (Booz-Allen and Hamilton, Inc., Florham Park, NJ (USA). Foster D. Snell Div.). Apr 1979. Contract EPA-68-02-2544. 452p. NTIS, PC A20/MF A01.

The major objective of the contract effort was to determine the direct economic impact of implementing RACT standards in Tennessee. The study is to be used primarily to assist EPA and state decisions on achieving the emission limitations of the RACT standards. The economic impact was assessed for the following 13 RACT industrial categories: surface coatings (cans, coils, paper, fabrics, metal furniture, large appliances); solvent metal cleaning; bulk gasoline terminals; refinery systems; bulk gasoline plants; storage of petroleum liquids in fixed roof tanks; gasoline dispensing stations--Stage I; and use of cutback asphalt. The scope of this project was to determine the costs and direct impact of control to achieve RACT guideline limitations for these 13 industry categories in Tennessee.

Direct economic costs and benefits from the implementation of RACT limitations were identified and quantified while secondary impacts (energy, employment, etc.) are addressed, they were not a major emphasis in the study.

14216 (PB—297512) **Economic impact of implementing RACT guidelines in the State of Georgia.** (Booz-Allen and Hamilton, Inc., Florham Park, NJ (USA). Foster D. Snell Div.). Mar 1979. Contract EPA-68-02-2544. 405p. NTIS, PC A18/MF A01.

The major objective of the contract effort was to determine the direct economic impact of implementing RACT standards in Georgia. The study is to be used primarily to assist EPA and Georgia decisions on achieving the emission limitations of the RACT standards. The economic impact was assessed for the following RACT industrial categories: surface coatings (cans, paper, fabrics, automobiles, metal furniture and large appliances); solvent metal cleaning; bulk gasoline terminals; bulk gasoline plants; storage of petroleum liquids in fixed roof tanks; gasoline dispensing stations--Stage I; and use of cutback asphalt. The scope of this project was to determine the costs and direct impact of control to achieve RACT guideline limitations for these 12 industry categories in Georgia. Direct economic costs and benefits from the implementation of RACT limitations were identified and quantified while secondary impacts (social, energy, employment, etc.) are addressed, they were not a major emphasis in the study.

14217 **Clean Air Act Amendments of 1977: new dimensions in air quality management.** Bauman, R.D. (Environmental Protection Agency, Research Triangle Park, NC). pp 23-26 of Gas from coal for industry: direct utilization of coal problems and solutions. Hahn, O.J.; MacClellan, D.T.; De Vore, R.W. (eds.). Lexington, KY; ORES Publications (Aug 1978).

From 5. energy resources conference; Lexington, KY, USA (10 Jan 1978).

The first Clean Air Act was passed by Congress in 1963, but it was not until the amendments of 1970 were passed that the nation's air pollution control program was given firm goals and a clear directive as to how to attain these goals. The Clean Air Act Amendments of 1977 provide a strong mandate indicating that Congress does not intend that the nation's energy problem be allowed to compromise environmental quality. It provides a major incentive to resolve potential conflicts between environmental goals and energy, economics, and employment concerns. The key provisions of the Act are discussed, with some comments on its relation to coal substitution for oil and gas and implementing Congress' mandate with respect to fossil-fuel fired steam generators.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

14218 (DOE/EV/10026—1) **Development of a center for biosystmeatics resources. Progress report, November 1, 1978-October 31, 1979.** Edwards, S.R. (Kansas Univ., Lawrence (USA)). Nov 1979. Contract AC02-79EV10026. 11p. Dep. NTIS, PC A02/MF A01.

The objective in the development of a Center for Biosystematics Resources is to provide a centralized source of information regarding the biological expertise available in the academic/museum community; and the federal and state regulations concerning the acquisition, transport, and possession of biological specimens. Such a Center would serve to facilitate access to this widely dispersed information. The heart of the Center is a series of computer assisted data bases which contain information on biologists and their areas of expertise, biological collections, annotated federal regulations, and federal and state controlled species lists. The purpose of this three-year contract with the Department of Energy is to continue the updating and revision of these data bases, make the information they contain readily available to the Department of Energy, other government agencies, the private sector, and the academic community; and to achieve financial independence by the end of the three-year period.

BASIC STUDIES

14219 (RHO-SA—121) **Application of hydraulic conductivity scaling to infiltration: drainage field tests.** Sisson, R.B.; Gibbs, A.G. (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Jul 1979. Contract EY-77-C-06-1030. 11p. (CONF-7908100—1). Dep. NTIS, PC A02/MF A01.

From American Society of Agronomy conference; Ft Collins, CO, USA (5 Aug 1979).

Spatial variability of hydraulic properties is of theoretical and practical importance in soil physics. Theoretically, there is the question as to how the variability might be best incorporated into existing predictive equations. Practically, spatial variability requires a large number of field and laboratory observations to characterize a soil. Scaling of hydraulic properties of soils is developed, treating spatial variability vertically. The vertical scaling results in a scaled depth coordinate and a scaled moisture content. Once this vertical scaling has been accomplished, the scaled profile concept of Warrick, et al (1977) is used to combine profiles from different locations across the field.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 13933

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 14426

14220 (PB—292565) **The role of plant residues in the fate of cadmium in ecosystems, a buffer against contamination of water sources. Technical completion report, 1 July 1976—30 September 1978.** Ndu, F.O.C.; Grant, D.M.; Somers, G.F. (Delaware Univ., Newark (USA). School of Life and Health Sciences). 30 Sep 1978. Contract DI-14-34-0001-8008. 29p. NTIS, PC A03/MF A01.

Cadmium was applied in simulated rain to the surface of 1 sq m plots of the litter in a mixed, deciduous hardwood woodlot shortly after leaf fall, either as single applications of 250 or 1250 micrograms or as serial applications at 20-day intervals of 25 or 1250 micrograms. The litter was collected periodically, divided into new, old (partially decayed), and humus fractions and analyzed for Cd content. Samples of soil were also analyzed. The ambient Cd content of the litter was so high that only the highest dosage rates produced significant increases in Cd content. The contaminant moved very slowly through the litter over a period of 18 months. During the first five months only the new litter, that on the surface and to which the contaminant had been applied, showed significantly increased Cd content. During the second winter season this became incorporated largely into the partially decomposed fraction as a result of the additional leaf fall. An additional study with ever larger amounts of Cd (5 mg/sq m) confirmed the high affinity of litter, in situ, for this element. Laboratory studies using 109Cd and a pulse-chase procedure confirmed the slow movement of cadmium through litter, regardless of the fraction.

14221 **Measuring trace amounts of elements from flame emission by a method of pulse registration with separation of the evaporation, atomization, and excitation zones.** Prudnikov, E.D. *Zh. Prikl. Spektrosk.;* **24**: No. 4, 571-575(Apr 1976). (In Russian).

On investigating the evaporation and atomization of elements from a carbon rod heated by an electric current, two processes were noted: evaporation of the elements at sufficiently low temperatures in comparison with the flame temperature, and evaporation of the elements without atomization in the form of easily volatile compounds. These processes may have a considerable effect on the distribution of free atoms over the evaporator during flameless atomic absorption measurements, and on the distribution of excited atoms during pulse measurements from flame emission. On taking these processes into account a look is taken at the problem of optimizing the pulse emission measurements with a nitrous oxide-acetylene flame. A scheme of registration is adopted with separation of the evaporation, atomization, and excitation zones in the flame. A double needle burner is used for the nitrous oxide-acetylene flame. The lower burner, in which the microprobe heated by an electric current is inserted, serves to evaporate, atomize, and transport the elements, while the upper burner placed over the microprobe serves to atomize and excite the elements. The emission is recorded at a height of 10 mm over the microprobe; the background from the incandescent microprobe is shielded, and the zone subjected to photometric analysis is focused on a slit of the spectral analyzing unit. With this registration scheme it is possible to eliminate the effect of particular radiation from the microprobe and changes in flame background. The limits of detecting elements are lowered by an order of magnitude. It is shown that it is possible to detect 10^{-10} to 10^{-13} grams of Sr, Al, V, Mo, Sm, Eu, Er, Yb. 12 references, 4 figures, 2 tables.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 14200

14222 (EML—366) **Radioanalytical laboratory exercise.** Volchok, H.L.; Feiner, M. (Department of Energy, New York (USA). Environmental Measurements Lab.). 2 Oct 1979. 45p. Dep. NTIS, PC A03/MF A01.

Fifteen institutions participated in a laboratory intercomparison involving seven natural matrix samples and six radionuclides. The exercise was organized and coordinated by the Environmental Measurements Laboratory. In some of the samples the radionuclide concentrations were known quite well and in those it was observed that in spite of differences among laboratories, the median of all reported values rather accurately represents the true concentration.

14223 (PNL-TR—376) **Transuranic elements in nature: plutonium around us.** Keller, C.; Alleluia, I.B. Translated from *Bild Wiss.*; No. 1, 56-65(1979). 25p. Dep. NTIS, PC A02/MF A01.

The potential hazards associated with the presence in the environment of plutonium is discussed. The origins and distribution of plutonium are reviewed. Two accidents involving the release of plutonium and subsequent clean-up efforts are described. It is concluded that artificially produced plutonium does not, as of yet, pose a significant health hazard.

SOIL

REFER ALSO TO CITATION(S) 13172, 13173, 13178, 13182, 13954, 14201

14224 (LA—8180-PR) **Environmental and radiological safety studies: interaction of $^{238}PuO_2$ heat sources with terrestrial and aquatic environments. Progress report, July 1-September 30, 1979.** Waterbury, G.R. (comp.). (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

The containers for $^{238}PuO_2$ heat sources in radioisotope thermoelectric generators are designed with large safety factors to ensure that they will withstand reentry from orbit and impact with the earth and safely contain the nuclear fuel until it is recovered. Existing designs have proved more than adequately safe, but the Office of the Assistant Director for Safety and Reliability of the Department of Energy Division of Advanced Systems and Materials Production continually seeks more information about the heat sources to improve their safety. The work discussed here includes studies of the effects on the heat source of terrestrial and aquatic environments to obtain data for design of even safer systems. The data obtained in several ongoing experiments are presented; these data tables will be updated quarterly. Discussions of experimental details are minimized and largely repetitive in succeeding reports. Compilations of usable data generated in each experiment are emphasized. These compilations include data from environmental chamber experiments that simulate terrestrial conditions, experiments to measure PuO_2 dissolution rates, soil column experiments to measure sorption of plutonium by soils, and several aquatic experiments. No reference to results cited in this report should be published without the explicit permission of the person in charge of this work.

14225 (PB—292460) **Radionuclide interactions with soil and rock media. Volume 1: processes influencing radionuclide mobility and retention, element chemistry and geochemistry, conclusions and evaluation. Final report.** Ames, L.L.; Rai, D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1978. Contract EPA-68-03-2514. 330p. NTIS, PC A15/MF A01.

The interactions of nineteen radionuclides with soil and rock media in the literature to 1977 were reviewed. The radionuclides were those of the elements americium, antimony, cerium, cesium, cobalt, curium, europium, iodine, neptunium, plutonium, promethium, radium, ruthenium, strontium, technetium, thorium, tritium, uranium and zirconium. The review included a brief summary of natural soil and rock distributions, chemistry, solid and solution equilibria and laboratory and field adsorption and migration results. It was concluded that most of the values for radionuclide-geologic media distribution coefficients in the literature were inadequate due to failure to include a comprehensive description of system conditions. Areas for future work suggested by the review included determination of adsorption mechanisms and kinetics, influence of redox potential on antimony, iodine, neptunium, plutonium, technetium and uranium migration potential, influence of organic ligands on radionuclide migration potential, thermodynamic data determinations of solid and solution species, generation of distribution coefficient data that can be used in a comparative mode and maintenance of the data in a bank with general access available.

14226 (PB—292461) **Radionuclide interactions with soil and rock media. Volume 2, part a and part b, annotated bibliography. Final report.** Ames, L.L.; Rai, D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1978. Contract EPA-68-03-2514. 1345p. NTIS PCE17/MF E05.

The purpose of this bibliography is to abstract the information on radionuclide-soil/rock interactions available in the literature. A total of 19 elements were considered including americium, antimony, cerium, cesium, cobalt, curium, europium, iodine, neptunium, plutonium, promethium, radium, ruthenium, strontium, technitium, thorium, tritium, uranium and zirconium. An index by element and subject is given at the end of the bibliography. The information for this report was obtained from various journals, books, past bibliographies, scientific reports and abstracting services such as Chemical Abstracts and Nuclear Science Abstracts. An effort was made to include all relevant information published from 1944 to December 1976. The bibliography is divided into volumes. Volume I contains letters A through Mc, while Volume II contains M through Z and the index.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 14198, 14244

14227 (COO—1156-117) **Radioecology of natural systems. Final report, May 1, 1962-October 31, 1979.** Whicker, F.W. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). 31 Oct 1979. Contract EY-76-S-02-1156. 56p. Dep. NTIS, PC A04/MF A01.

This is the final report to the US Department of Energy and its predecessors on Contract EY-76-S-02-1156 with Colorado State University. During the first five years of the program, investigations were focused on the accumulation of fallout radionuclides in a well-studied mule deer population in north-central Colorado. In 1967, the scope of the program was enlarged to include studies on radionuclide behavior in mountain lake ecosystems, radiation effects on a shortgrass plains ecosystem, and the combined effects of radiation and intraspecific competition on the pika (Ochotona princeps). In 1971, studies on the geochemistry of lead in an alpine lake and the foraging impact of grasshoppers were added to the diverse program. The summer of 1972 marked the beginning of the research program which was to dominate the effort for the duration of the contract, namely the behavior of plutonium in the terrestrial environs of the Rocky Flats plutonium facility near Denver, Colorado. This report is a general, qualitative summary of activities and major findings over the entire tenure of the program.

14228 (EMSL-LV—0539-28) **Comparison of the solubility of plutonium-238 and plutonium-239 dioxide in in vitro bovine ruminal-gastrointestinal fluids.** (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Nov 1979. Contract EY-76-A-08-0539. 15p. Dep. NTIS, PC A02/MF A01.

The alimentary solubility and behavior of plutonium-238 dioxide and plutonium-239 dioxide were compared in an artificial rumen and simulated bovine gastrointestinal fluids. Rumen juice was augmented with plutonium-238 dioxide particles of 0.096-μm count median diameter or plutonium-239 dioxide particles of 0.121-μm count median diameter and incubated for 24 hours. This juice was successively converted by the addition of bile and enzymes and adjustment of the pH to simulate the digestive stages of the abomasum, duodenum, jejunum, and lower small intestine. Fluid samples were collected from each of these digestive stages and radioanalyzed for soluble plutonium-238 or plutonium-239. Shortly after the addition of plutonium-238 dioxide to rumen juice, an average of 0.12 percent became soluble while 0.33 percent became soluble following the incubation period. The solubility increased to 0.05 percent following the abomasal incubation period and increased to 0.79 percent and 1.10 percent when the fluid was maintained at pH 4.0 and 5.0, respectively, during the duodenal phase. The solubility increased to 3.20 percent following the addition of bile and enzymes and adjustment of the pH to 6.0 and to 3.62 percent following the 2-hour jejunal incubation period. Plutonium-239 dioxide was 0.00123 percent soluble shortly after being administered to the rumen juice while 0.00256 percent became soluble following the incubation period. Following the abomasal incubation period the solubility decreased to 0.00189 percent and then increased to 0.00604 percent when the fluid was held at pH 4.5 to simulate the duodenum. There was a further increase in solubility to 0.0138 percent following the jejunal incubation phase.

14229 (PB—295563) **Central florida phosphate industry. Volume II. background and alternatives assessment. Final report.** (Environmental Protection Agency, Atlanta, GA (USA). Region IV). Nov 1978. 184p. NTIS PC A09/MF A01.

The Central Florida Phosphate District encompasses an area of approximately 2000 square miles in Polk, Hillsborough, Manatee, Hardee, and DeSoto Counties, Florida. There are currently 17 potential new source mines in the district. This EIS assessed areawide and cumulative effects on the entire area and provides the basis for development of site specific EISs. The final EIS establishes a scenario of phosphate development which was determined to be as compatible as practicable with other desired and intended land uses in Central Florida. Volume II describes the Central Florida Phosphate Industry and the Natural and man-made environments of the study area. Several scenarios are presented as decision alternatives and primary and secondary effects are assessed and compared.

14230 (PNL—2850(Pt.4), pp 2.43-2.44) **Analytical techniques for measurement of ^{99}Tc in environmental samples.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Three new methods have been developed for measuring ^{99}Tc in environmental samples. The most sensitive method is isotope dilution mass spectrometry, which allows measurement of about 1 x 10^{-12} grams of ^{99}Tc. Results on analysis of five samples by this method compare very well with values obtained by a second independent method, which involves counting of beta particles from ^{99}Tc and internal conversion electrons from /sup 97m/Tc. A third method involving electrothermal atomic absorption has also been developed. Although this method is not as sensitive as the first two techniques, the cost per analysis is expected to be considerably less for certain types of samples.

14231 Behaviour of tritium in the environment. Report on the international symposium held in San Francisco from 16 to 20 October 1978. Farges, L. (International Atomic Energy Agency, Vienna (Austria)); Jacobs, D. (Oak Ridge National Lab., TN (USA)). *At. Energy Rev.;* **17**: No. 1, 213-217(Mar 1979).

Recent advances and the practical aspects of ^{3}H-utilization and monitoring are discussed. A reasonably complete picture exists of the behaviour of tritiated water (HTO) but information on tritiated gas and methane is less certain. The T/H ratio in water vapour over continental areas is about 3.5 to 4 times that over oceanic areas. ^{3}H can be used for developing chronological information in ice caps at the south pole. Watches with liquid crystal display use ^{3}H. Uncontrolled releases from fuel processing plants could contribute 35 to 60% of the maximum total ^{3}H body dose (>30mrem/year for a 100m stack). Global models for ^{3}H-concentration are highly dependent on the surface-water depth considered. T/H in the aquatic medium is discussed. In 1972, the oceanic inventory of ^{3}H was approximately 1640MCi (mostly in the Northern Hemisphere), with most of ^{3}H at a depth of less than 1000m. Terrestrially, rapid ^{3}H-loss is mainly due to evapotranspiration. When HTO penetrates more deeply into soil, the residence time increases. ^{3}H-retention in man can be characterized by a summation of 4 exponential terms, with successively increasing half-times.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 13519

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 12992, 13049, 13169, 13670

14232 (PB—295861) **Illinois Institute for Environmental Quality, annual report, fiscal year 1975. Final report.** (Illinois Inst. for Environmental Quality, Chicago (USA)). 1975. 25p. NTIS PC A02/MF A01.

The Illinois Institute for Environmental Quality completed many needed projects and studies during Fiscal Year 1975. Often, the findings of one individual project answered different environmental questions, and affected a number of the Institute's major responsibilities. And this is as it should be, for the air we breathe, the water we drink, and the sounds we hear - all are part of one environment. This annual report provides detailed information about the Institute's major projects and activities, and the many ways their interrelated results combine to improve the environment of Illinois.

14233 (PB—297103) **The Ohio River Basin. The regional water and land resources plan and environmental, economic and social impact statements.** (Ohio River Basin Commission, Cincinnati (USA)). Jan 1979. 112p. NTIS, PC A06/MF A01.

The Environmental Impact Statement summarized here identifies the net impacts of the actions recommended in the plan as a whole. This document is an overall summary and analysis of the plan for the basin as presented in 15 volumes (this summary and one for each subregional portion of the basin). Contained in this summary and analysis document are the generalized recommendations and Commission strategy for meeting identified needs and problems. The recommended plan consists of 1,233 projects including 96 Public law-566 watershed and Research and Development projects, three navigation projects, seven reservoir projects, 45 local flood protection projects, 793 municipal water quality control measures, 107 recreation areas, nine state wild and scenic rivers, 102 natural areas, 69 fish and wildlife areas, and two hydroelectric power projects. Also included in the plan, but not reflected in these numbers, are programmatic recommendations for agriculture/forest land treatment, flood plain management, and energy development.

14234 (PB—298049) **Rehabilitation of western wildlife habitat: A review.** (Utah State Univ., Logan (USA). Inst. of Land Rehabilitation). Dec 1978. Contract DI-14-16-0008-2110. 252p. NTIS, PC A12/MF A01.

This publication provides a review of information (previously available from other research sources) regarding both the habitat requirements of key wildlife species and the major land rehabilitation techniques that have been proven successful. The geographic focus is on those habitats and rehabilitation efforts which are west of the cultivated prairies, with special emphasis placed on actual or anticipated sites of surface mining.

REGULATIONS

REFER ALSO TO CITATION(S) 13049, 13719, 14248, 14249

14235 (PB—295519) **Profile of environmental quality: Region 8, Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming.** (Environmental Protection Agency, Denver, CO (USA). Office of Public Awareness). Oct 1978. 32p. NTIS PC A03/MF A01.

This report presents a brief overview of some of the problems which affect environmental quality in the Region VIII states of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. It also discusses EPA's programs aimed at dealing with these problems. Some color maps and graphs may not reproduce satisfactorily.

ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 14218

BASIC STUDIES

REFER ALSO TO CITATION(S) 13117

14236 (BNL—51069) **Biological consequences of environmental changes related to coastal upwelling: a simulation study.** Howe, S.O. (Brookhaven National Lab., Upton, NY (USA)). May 1979. Contract EY-76-C-02-0016. 134p. Dep. NTIS, PC A07/MF A01.

Two simulation models of marine ecosystem dynamics are formulated and applied to field data. The first is a time-dependent model of phytoplankton growth in nutrient-enriched batch cultures where spatial gradients of dependent variables and the effects of higher tropic level processes are not included. Rates of photosynthesis, nutrient uptake, chlorophyll synthesis and cell division for a single phytoplankton functional group are simulated as functions of photosynthetically active solar radiation, dissolved nutrient concentrations and cell quotas of carbon, nitrogen and silica. The second model combines the phytoplankton growth model with a time dependent, two-dimensional model of coastal upwelling off northwest Africa.

14237 Ferromagnetism in freshwater bacteria. Blakemore, R.P. (Univ. of New Hampshire, Durham); Frankel, R.B.; Wolfe, R.S. pp 400-407 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

Magnetotactic bacteria isolated from swamp water were grown in pure culture in the laboratory. This newly isolated species was cultured in the magnetic and the nonmagnetic state. Magnetic cells, which were rich in iron, also produced particles similar to those found previously in other magnetic bacteria of marshes and bogs. By contrast, their nonmagnetic counterparts had much lower iron levels and lacked the crystal structures. Moessbauer spectroscopic analyses of whole cells of magnetic bacteria indicated that they contained the mineral magnetite.

RADIOMETRIC TECHNIQUES

REFER ALSO TO CITATION(S) 13933

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 13042, 13065, 13066, 13116, 13931, 14165, 14220, 14221, 14293

14238 (BNL—27089) **Acidification of aquatic ecosystems: ecosystem sensitivity and biological consequences.** Hendrey, G.R. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 29p. (CONF-791163—1). Dep. NTIS, PC A03/MF A01.

From Action seminar on acid precipitation; Toronto, Canada (1 Nov 1979).

The current state of knowledge concerning acidic precipitation is presented at a non-technical level. The chemistry of the acidification of surface waters is explained; areas sensitivie to acid rain as a result of geology and topography are delineated; and the biological consequences of acidification are discussed. (ACR)

14239 (PB—290958) **Program activities, 12th annual report. Annual report, 1 July 1975-30 June 1976.** (Maryland Univ., College Park (USA). Water Resources Research Center). 1976. 64p. NTIS, PC A04/MF A01.

The current activities (1975-76) of the Maryland Water Resources Research Center are summarized. The current status of the following projects is reported: Heavy metals and minerals in Chesapeake Bay sediments; toxicity of waste water treatment plant effluents to fishes; mathematical model for estimating water quality loadings; groundwater fluctuation under heavy irrigation with sewage effluents; treatment costs versus environmental damage in state water resources management; water quality changes in oyster processing; mutagenic potential of petroleum byproducts in Chesapeake Bay waters; detection of enteroviruses surviving standard sewage treatment; detection of bacterial pathogens surviving standard sewage treatment; biotoxicity of chlorine species to copepods; marsh ecosystem response to nutrients in agricultural runoff; characteristics of urban runoff, and the effects of a cooling tower on the environment.

14240 (PB—294980) **Aerial reconnaissance of hazardous substances spills and spill-threat conditions. Final report.** Johnson, H.V. (Lockheed Electronics Co., Inc., Las Vegas, NV (USA). Remote Sensing Lab.). Apr 1979. Contract EPA-68-03-2636. 73p. NTIS PC A04/MF A01.

The U.S. Environmental Protection Agency's Environmental Monitoring and Support Laboratory in Las Vegas, Nevada, conducted aerial reconnaissance over a number of industrial facilities engaged in the production, storage, and handling of hazardous substances that are located near navigable waters of the United States. The purpose of this project was to demonstrate that aerial reconnaissance procedures currently utilized in monitoring oil production, refining, and storage facilities can be applied to monitoring chemical production and storage facilities to show whether spills and spill-threat conditions exist within chemical production and storage facilities, and to provide annotated photographic examples of spills and spill-threat conditions exist within chemical production and storage facilities, and to provide annotated photographic examples of spill conditions. Typical in-plant facilities covered in this reconnaissance include: (1) product storage facilities, including storage and holding tanks, drum storage and staging areas, and dry-product stockpiles; (2) product transfer facilities, such as marine and river terminals, and tank car and truck loading racks; and (3) plant drainage and wastewater treatment facilities. The photographic examples can serve as photo interpretation keys to aid both experienced remote sensing specialists and inexperienced personnel in monitoring chemical facilities for compliance with anticipated spill prevention regulations to be issued under authority of the Federal Water Pollution Control Act (FWPCA) as amended in 1977.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 14222, 14229

14241 (COO—2529-12) **Plutonium and cesium radionuclides in the Hudson River estuary and other environments. Annual technical progress report, December 1, 1978-November 30, 1979.** Simpson, H.J.; Trier, R.M. (Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory). 1979. Contract EY-76-S-02-2529. 171p. Dep. NTIS, PC A08/MF A01.

Radionuclide activities were measured in a large number of sediment cores and suspended particle samples throughout the salinity range of the Hudson River estuary. Activities of ^{137}Cs, ^{134}Cs and ^{60}Co determined by gamma spectrometry and $^{239,240}Pu$ and ^{238}Pu determined by alpha spectrometry indicate reasonably rapid accumulation rates in the sediments of marginal cove areas, and very rapid deposition in the harbor region adjacent to New York City. General distributions of ^{137}Cs and $^{239,240}Pu$ are similar in surface sediments and with depth in cores, but there are deviations from the fallout ratio due to addition of reactor ^{137}Cs and loss of ^{137}Cs from the particle phases at higher salinities. Measurable amounts of reactor-derived ^{134}Cs and ^{60}Co are found in nearly all sediment samples containing appreciable ^{137}Cs between 15 km upstream of Indian Point and the downstream of our sampling about 70 km south of the reactor. Accumulations of $^{239,240}Pu$ in New York harbor sediments are more than an order of magnitude greater than the fallout delivery rate, probably primarily due to the accumulation of fine particles containing fallout plutonium in the harbor which have been transported from upstream areas of the Hudson. Measurements of fallout $^{239,240}Pu$ in a saline lake with a high carbonate ion concentration yielded water column activities about two orders of magnitude greater than has been found for fallout plutonium in other continental waters, indicating extensive mobility in some natural water environments. Experiments using lake water suggest that carbonate ion may indeed be a critical factor in regulatory plutonium solubility.

WATER

REFER ALSO TO CITATION(S) 13161, 13175, 14224

14242 (PB—295321) **Determination of radium removal efficiencies in water treatment processes. Technical note.** Brinck, W.L.; Schliekelman, R.J.; Bennett, D.L.; Bell, C.R.; Markwood, I.M. (Office of Radiation Programs, Washington, DC (USA). Technology Assessment Div.; Iowa Dept. of Environmental Quality, Des Moines (USA)). Dec 1976. 27p. NTIS PC A03/MF A01.

Numerous well-water supplies for public water systems contain naturally occurring radium-226. Methods for removing radium from drinking water are needed so that drinking water treatment plants may meet the limit set in the EPA drinking water regulations for radium in drinking water. Studies were performed by State agencies at 14 cities in Iowa and Illinois to determine the radium removal efficiency of four water treatment processes. Populations served by the water treatment plants ranged from 235 to 25,000. The radium-226 concentration in the raw water was greater than 5 pCi/liter at 13 of the supplies and ranged from 3 to 49 pCi/liter. Radium removal efficiencies at plants using reverse osmosis and sodium ion-exchange processes were generally about 92%. A much wider range of removal efficiencies, 75% to 95%, was found at plants using the lime-soda ash softening process with the removal varying with process pH. Plants using iron removal processes only were found to have radium removals ranging from 11% to 53%.

14243 (PNL—3160-1) **Variable thickness transient ground-water flow model. Volume 1. Formulation.** Reisenauer, A.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1979. Contract EY-76-C-06-1830. 35p. Dep. NTIS, PC A03/MF A01.

Mathematical formulation for the variable thickness transient (VTT) model of an aquifer system is presented. The basic assumptions are described. Specific data requirements for the physical parameters are discussed. The boundary definitions and solution techniques of the numerical formulation of the system of equations are presented.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 14198, 14227, 14231

14244 (ORNL/TM—7039) **Estimated radiological doses to the maximumly exposed individual and downstream populations from releases of tritium, strontium-90, ruthenium-106, and cesium-137 from White Oak Dam.** Little, C.A.; Cotter, S.J. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 41p. Dep. NTIS. PC A03/MF A01.

Concentrations of tritium, ^{90}Sr, ^{106}Ru, and ^{137}Cs in the Clinch River for 1978 were estimated by using the known 1978 releases of these nuclides from the White Oak Dam and diluting them by the integrated annual flow rate of the Clinch River. Estimates of 50-year dose commitment to a maximumly exposed individual were calculated for both aquatic and terestrial pathways of exposure. The maximumly exposed individual was assumed to reside at the mouth of White Oak Creek where it enters the Clinch River and obtain all foodstuffs and drinking water at that location. The estimated total-body dose from all pathways to the maximumly exposed individual as a result of 1978 releases was less than 1% of the dose expected from natural background. Using appropriate concentrations of to subject radionuclides diluted downstream, the doses to populations residing at Harriman, Kingston, Rockwood, Spring City, Soddy-Daisy, and Chattanooga were calculated for aquatic exposure pathways. The total-body dose estimated for aquatic pathways for the six cities was about 0.0002 times the expected dose from natural background. For the pathways considered in this report, the nuclide which contributed the largest fraction of dose was ^{90}Sr. The largest dose delivered by ^{90}Sr was to the bone of the subject individual or community.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 14239

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 13168, 13593, 14232

14245 (PB—296822) **The virgin islands coastal management program. Final environmental impact statement.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). Mar 1979. 272p. NTIS PC A12/MF A01.

The report has been divided into five parts: Introduction and Overview; Context for Planning; The Management Program; Environmental Impacts; and Appendices. The process used in developing the coastal zone management program is summarized. The six major Federal requirements involved certain technical tasks, as well as interaction with a wide array of governmental agencies, citizens groups and individuals. These tasks include resource inventories and capability analysis, legal institutional analysis, attitude-value survey, economic and social needs-demand study, and a visual quality-aesthetic assessment. The methodologies and objectives of each are outlined. The Program provides a sound basis for decision making, protects the important natural systems and directs uses to areas with natural capabilities and infrastructure capabilities to absorb growth. It will contribute to the long-term maintenance of the environment.

REGULATIONS

REFER ALSO TO CITATION(S) 13668

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 13068, 13665, 13667, 13698, 13742, 14215, 14216, 14233

14246 (PB—292276) **A social, economic and cultural study of the Crow reservation: implications for energy development. Summary report, May 1976—July 1977.** Feighter, Y.; Nordstrom, J. (Northern Cheyenne Research Project, Lame Deer, MT (USA); Mountain West Research, Inc., Tempe, AZ (USA)). Jul 1977. Contract OWRC-10670221. 26p. NTIS, PC A03/MF A01.

The study was conducted to: (1) evaluate the current socio-economic and cultural conditions prevailing on the reservations; (2) determine attitudes and feelings of inhabitants concerning energy development; (3) establish socioeconomic projections; (4) establish reliable impact research methods for monitoring social change; (5) train Tribal persons in all phases of the research. This report is a summary of information contained in the Final Report of the Crow Impact Study.

14247 (PB—292277) **A social, economic and cultural study of the Crow reservation: implications for energy development. Final report, May 1976—July 1977.** Feighter, Y. (Northern Cheyenne Research Project, Lame Deer, MT (USA); Mountain West Research, Inc., Tempe, AZ (USA)). Jul 1977. Contract OWRC-10670221. 276p. NTIS, PC A13/MF A01.

The study was conducted to provide more information on the current conditions existing on the Crow and Northern Cheyenne Reservations in Southeastern Montana. The reservations contain an estimated 10 billion tons of coal. The objectives of the project are: (1) to evaluate the current socio-economic and cultural conditions prevailing on the reservations; (2) to determine attitudes and feelings of inhabitants concerning energy development; (3) to establish socio-economic methods for monitoring social change and (4) to train Tribal persons in all phases of the research. This report is a detailed report on the Crow Tribe.

14248 (PB—293148) **A legal study relating to coal development - population issues. Volume I. Responding to rapid population growth. Final report, June—September 1974.** Scott, J.J. (Kutak, Rock, Cohen, Campbell, Garfinkle and Woodward, Omaha, NE (USA)). Sep 1974. Contract OWRC-10470004. 132p. NTIS, PC A07/MF A01.

The study is both regional and nationwide in scope. In order to identify and evaluate the problems which may be expected to arise in areas of rapid population growth, a nationwide survey has been made of areas which have experienced such growth in the past. From this survey there has been distilled a summary and analysis of the kinds of problems which arise in rapid-growth areas, and a summary and analysis of the ways in which local and state governments have responded to those problems. This material is contained in Volume One, which also sets forth certain 'principles for legislation' based upon the experience of these areas of previous rapid growth.

14249 (PB—293150) **A legal study relating to coal development - population issues. Volume III. summary of Montana, North Dakota and Wyoming statutes: financing and population issues. bibliographies. Final report, June—September 1974.** Scott, J.J. (Kutak, Rock, Cohen, Campbell, Garfinkle and Woodward, Omaha, NE (USA)). Sep 1974. Contract OWRC-10470004. 435p. NTIS, PC A19/MF A01.

Volume Three contains outlines of land-use planning and special improvement district legislation selected from the statutes of the states of Montana, North Dakota and Wyoming. A more comprehensive narrative description of the statutes related to the financing of public facilities in each of these states is also included in Volume Three. The final portion of this volume is a series of bibliographies selected and organized to be of maximum use in formulating responses to the problems of rapid population growth.

14250 (PB—293151) **A legal study relating to coal development - population issues. Volume IV. Montana statutes relating to rapid population growth. Final report, June—September 1974.** Scott, J.J. (Kutak, Rock, Cohen, Campbell, Garfinkle and Woodward, Omaha, NE (USA)). Sep 1974. Contract OWRC-10470004. 557p. Microfiche copies only.

Volume Four is a selective collection of Montana statutes arranged in accordance with a specially devised subject matter outline entitled the Common Index and incorporating all amendments enacted prior to September 3, 1974. This Common Index is a comprehensive summary of topics which must be addressed in order to effectively respond to rapid population influx. The Index is comprised of five major topics with each representing a general category of anticipated problems. Subdivisions have been prepared within each major topic based upon either topical or state-county-city distinctions. Thus, as completed for each state, the Common Index may accurately be described as an abbreviated catalog of the legal and regulatory issues relevant to the problems of rapid population influx and a summary of that state's statutory response or lack thereof, to those issues.

14251 (PB—293152) **A legal study relating to coal development - population issues. Volume V. North Dakota statutes relating to rapid population growth. Final report, June—September 1974.** Scott, J.J. (Kutak, Rock, Cohen, Campbell, Garfinkle and Woodward, Omaha, NE (USA)). Sep 1974. Contract OWRC-10470004. 337p. Microfiche copies only.

Volume Five is a selective collection of North Dakota statutes arranged in accordance with a specially devised subject matter outline entitled the Common Index and incorporating all amendments enacted prior to September 3, 1974. This Common Index is a comprehensive summary of topics which must be addressed in order to effectively respond to rapid population influx. The Index is comprised of five major topics with each representing a general category of anticipated problems. Subdivisions have been prepared within each major topic based upon either topical or state-county-city distinctions. Thus, as completed for each state, the Common Index may accurately be described as an abbreviated catalog of the legal and regulatory issues relevant to the problems of rapid population influx and a summary of that state's statutory response or lack thereof, to those issues.

14252 (PB—293153) **A legal study relating to coal development - population issues. Volume VI. Wyoming statutes relating to rapid population growth. Final report, June—September 1974.** Scott, J.J. (Kutak, Rock, Cohen, Campbell, Garfinkle and Woodward, Omaha, NE (USA)). Sep 1974. Contract OWRC-10470004. 440p. Microfiche copies only.

Volume Six is a selective collection of Wyoming statutes arranged in accordance with a specially devised subject matter outline entitled the Common Index and incorporating all amendments enacted prior to September 3, 1974. This Common Index is a comprehensive summary of topics which must be addressed in order to effectively respond to rapid population influx. The Index is comprised of five major topics with each representing a general category of anticipated problems. Subdivisions have been prepared within each major topic based upon either topical or state-county-city distinctions. Thus, as completed for each state, the Common Index may accurately be described as an abbreviated catalog of the legal and regulatory issues relevant to the problems of rapid popula-

tion influx and a summary of that state's statutory response or lack thereof, to those issues.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 13299, 13670, 13671

14253 (DOE/ER—0036/1) **Preliminary environmental assessment for the satellite power system (SPS). Revision 1. Volume 1. Executive summary.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Jan 1980. 64p. Dep. NTIS, PC A04/MF A01.

A preliminary assessment of the environmental impacts of the proposed satellite power system (SPS) is summarized here. In this system, satellites would collect solar energy in space, convert it to microwaves, and transmit the microwaves to receiving antennas (rectennas) on earth. At the rectennas, the microwaves would be converted to electricity. The assessment considers microwave and nonmicrowave effects on the terrestrial environment and human health, atmospheric effects, and disruption of communications and other electromagnetic systems.

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 14126

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 13987, 14263, 14272, 14287, 14291, 14300, 14306

14254 (LBL—7448, pp 61-80) **Structural biophysics.** 1977.

In Biology and Medicine Division annual report, 1977.

This group, led by Dr. Robert Glaeser, is composed of several subgroups that are carrying out a variety of studies involved with molecules, cell membranes, and intracellular contents, including the DNA-protein complexes within the cell nucleus. Special techniques have been devised to enable exploration of the finer structural details and to help understand the interactions taking place at the ultrastructural level.

14255 (LBL—9978) **Relation between surface charge changes in purple membranes and the photoreaction cycle in bacteriorhodopsin (halobacteria, bioenergetics, surface potentials).** Carmeli, C.; Quintanilha, A.T.; Packer, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

The surface potential of purple membrane fragments, determined from the distribution of the aqueous-free and the membrane-bound positively charged, paramagnetic, amphiphilic probe 4-(dodecyl dimethyl ammonium)1-oxyl-2, 2,6,6-tetramethyl piperidine bromide, varied almost 60 mV as a function of ionic strength and 50 mV as a function of pH of the medium. Light induced changes in surface potential followed the changes observed in the M_{412} intermediate of the photocycle of bacteriorhodopsin as a function of pH, temperature, and response to antibiotics Beauvericin and Valinomycin. The number of induced charges per M_{412} appearing at the surface of purple membranes decreases from 0.75 to 0.6 as the surface potential becomes more negative. The stoichiometric values would be twice as large if the charge changes were localized exclusively on one side of the purple membrane. Laser flash induced kinetics of the rise and decay of surface charge changes lagged behind the kinetics of the rise and decay of M_{412} which is associated with the reversible deprotonation of the retinal Schiff base nitrogen in the chromophore. It is suggested that the light induced charge changes monitor a dissociable amino acid residue which may be a step in the movement of protons across the purple membrane.

14256 (LBL—10122) **Spectroscopic and magnetic properties of the complexes of the heme octapeptide from cytochrome c.** Yang, E.K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 217p. Dep. NTIS, PC A10/MF A01.

Thesis.

Detailed ligand binding effects have been examined in a model system of cytochrome c, the N-acetylated ferric heme octapeptide (N-H8PT) directly isolated from horse heart cytochrome c. The room temperature absorption and magnetic circular dichroism (MCD) spectra of the complexes of N-H8PT with various external ligands such as F^-, H_2O, OH^-, N_3^-, imidazole (Im) and CN^- are found to behave generally as predicted from ligand field considerations. There is a direct correlation between the Soret absorption band position, β band intensity or the Soret MCD intensity and susceptibility. The N-acetylated methionine complex of the N-H8PT, however, exhibits thermal equilibrium of spins between high and low spin states, while cytochrome c exists in the purely low spin state. Temperatre dependence of paramagnetic susceptibility of the methionine complex yields ΔH° = -7.6 kcal/mole and ΔS° = -25.9 e.u. for a high spin to low spin transition demonstrating a compensation effect between the two thermodynamic parameters. The low temperature ESR spectrum of the methionine complex indicates a low spin ground state with g values at 2.91, 2.31, and 1.51 which are distinct from the g values of cytochrome c. The axial (Δ) and rhombic (V) distortion parameters in the t/sub 2g/ set of orbitals correspond to 1200 cm^{-1} and 780 cm^{-1}, respectively. From these results, a model is proposed to account for the uniqueness of the methionine complex: a change in Fe-S distance may play a role in regulating the redox properties of cytochrome c.

14257 (UCD—472-125, pp 95-96) **Production of a mesenchymal tumor in a nude mouse by the injection of stromal cells obtained from a lymph node of a beagle with malignant lymphoma.** Klein, A.K.; Wilson, F.D.; Shifrine, M.; Hinds, D. Oct 1979.

In Annual report, 1978-1979.

An extension of our model for the investigation of stromal elements in lymphohematopoiesis by the inoculation of attaching cells isolated from tissue cultures into athymic (nude) mice is described. The nude mouse transplantation model was originally developed for the study of human hematopoietic stromal elements and is shown in this report to be useful for the study of lymphohematopoietic stromal elements in the dog as well.

14258 **Photoinitiated mediated transport of H_3O^+ and/or OH^- across glycerol monooleate bilayers doped with magnesium octaethylporphyrin.** Young, R.C.; Feldberg, S.W. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Biophys. J.;* **27**: No. 2, 237-255(Aug 1979).

Photogenerated magnesium octaethylporphyrin cation in glycerol monooleate bilayers is shown to mediate the transport of H_3O^+ and/or OH^-. Data from voltage clamp and open-circuit experiments are consistent with the classic Markin or Laueger carrier model. Photoinitiated currents exhibit the expected transient and steady-state behavior.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 14282, 14303

14259 **Time-resolved electron spin echo spectroscopy applied to the study of photosynthesis.** Thurnauer, M.C.; Bowman, M.K.; Norris, J.R. (Argonne National Lab., IL (USA)). *FEBS (Fed. Eur. Biochem. Soc.) Lett.;* **100**: No. 2, 309-312(15 Apr 1979).

The reported studies of photosynthetic systems by time resolved magnetic resonance have utilized what are now fairly standard EPR techniques. They have been limited by lack of adequate time resolution, possible distortions or artifacts due to the use of magnetic field modulation, and the problem of positively identifying the observed radical species. The authors are applying time-resolved electron spin echo (ESE) spectroscopy, a pulsed form of EPR, to the study of photosynthetic systems. This new technique not only avoids many of the problems described above but also provides several new advantages. They report here on the first observation of spin-polarized signals in the blue-green alga Synechococcus lividus using time-resolved ESE, and illustrate advantages of the technique.

CYTOLOGY

REFER ALSO TO CITATION(S) 14273, 14295, 14306, 14370

14260 (CONF-7909115—1) **Cellular and genetic analysis of mouse blastocyst development.** Pedersen, R.A.; Spindle, A.I. (California Univ., San Francisco (USA)). 1979. Contract EY-76-C-03-1012. 46p. Dep. NTIS, PC A03/MF A01.

From Conference on cellular and molecular aspects of implantation; Houston, TX, USA (17 Sep 1979).

The development of mouse embryos was studied by both cellular and genetic approaches. In the cellular analysis, determination of cell fate in blastocysts and in cell populations derived from them was studied in an attempt to estimate the time that these cells become committed to their fate. In the genetic analysis, existing mutations that are lethal to mouse embryos were used to discern essential features of early development. In this review, the timing of cell determination in the inner cell mass and the primary ectoderm,

and the manifestation of defects in mouse embryos that are homozygous for the A/sup y/ allele of the agouti locus were considered.

14261 (LA—8143-T) **Determination of morphological parameters of biological cells by analysis of scattered-light distributions.** Burger, D.E. (Los Alamos Scientific Lab., NM (USA)). Nov 1979. Contract W-7405-ENG-36. 214p. Dep. NTIS, PC A10/MF A01.

Thesis.

The extraction of morphological parameters from biological cells by analysis of light-scatter patterns is described. A light-scattering measurement system has been designed and constructed that allows one to visually examine and photographically record biological cells or cell models and measure the light-scatter pattern of an individual cell or cell model. Using a laser or conventional illumination, the imaging system consists of a modified microscope with a 35 mm camera attached to record the cell image or light-scatter pattern. Models of biological cells were fabricated. The dynamic range and angular distributions of light scattered from these models was compared to calculated distributions. Spectrum analysis techniques applied on the light-scatter data give the sought after morphological cell parameters. These results compared favorably to shape parameters of the fabricated cell models confirming the mathematical model procedure. For nucleated biological material, correct nuclear and cell eccentricity as well as the nuclear and cytoplasmic diameters were determined. A method for comparing the flow equivalent of nuclear and cytoplasmic size to the actual dimensions is shown. This light-scattering experiment provides baseline information for automated cytology. In its present application, it involves correlating average size as measured in flow cytology to the actual dimensions determined from this technique. (ERB)

14262 (LA—8196-MS) **Correlation of several variables for pulmonary lavage samples from normal Syrian hamsters.** Wilson, J.S.; Steinkamp, J.A. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 7p. Dep. NTIS, PC A02/MF A01.

This study was designed to establish normal values for our pulmonary lavage techniques. Cell samples from normal Syrian hamsters were evaluated and correlated with animal weight and lavage volume. The data indicated a relationship between animal weight and cell yield, a variability in cell yield not related to lavage volume or alterations in cell populations, a maintenance of viability throughout the procedure, and the presence of three basic cell populations. Laser analysis demonstrated the capacity of flow cytometrics to measure DNA of heterogeneous rodent pulmonary lavage samples. Characterization of the cell populations by microscopic observation defined the cell types present, their relative numbers, and presented an element of variability of cell populations. Evaluation of normal rodent pulmonary lavage fluids obtained by this technique represents a necessary preliminary exercise in the development of medical applications of flow cytometrics systems.

14263 (LA-UR—80-331) **Correlation of the growth of Chinese hamster V_{79}-171b multicellular spheroids with cytokinetic parameters.** Johnson, T.S.; Bain, E.; Raju, M.R.; Martin, J.C. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 26p. (CONF-791137—2). Dep. NTIS, PC A03/MF A01.

From Engineering Foundation conference on automated cytology; Pacific Grove, CA, USA (25 Nov 1979).

The volumes of Chinese hamster V_{79}-171b multicellular spheroids grown in spinner culture were measured and correlated to DNA distribution and cell volume distribution information. Spheroid growth curves were obtained over a 21 day period using both electronic cell volume measurements and microscope micrometer sizing. The spheroids were collected from the aperture tube after electronic sizing, and single cell suspensions were prepared via trypsinization. Saline-washed cells were then stained with mithramycin and analyzed as unfixed orethanol-fixed cells for both cell volume and DNA fluorescence measurements. Spheroid growth was determined to have an initial 8 to 9 day rapid growth phase, and a slow phase from 10 to 21 days. The single cell volume distributions of cells obtained from spheroids were dependent on spheroid volume and the relative proportions of small volume noncycling cells to large volume cycling cells comprising the spheroids were also dependent on spheroid volume. DNA distribution data and dual parameter DNA distribution cell volume contour patterns obtained for single cells dissociated from spheroids were closely related to the measured spheroid volume and revealed that the fraction of small, hypoxic G_0-like cells was greatest in old, large spheroids.

14264 (LBL—10106) **In situ electron microscopy of cell monolayers: application to the study of the interactions between Balb 3T3 fibroblasts.** Collins T.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 268p. Dep. NTIS, PC A12/MF A01.

Thesis.

The present study was undertaken to determine whether freeze-fracture could be used to detect possible changes in the properties of Balb 3T3 cell membranes resulting from density-dependent inhibition of growth. An in situ technique for freeze-fracture of monolayer cultures was perfected and was found to increase greatly the yield of information available from replicas of cultured cells. To avoid changes in the properties of cultures which might result from variations in the growth conditions used for different experimental techniques, silicon monoxide was evaluated as a substratum for growing cells during all biochemical and morphological experiments. Vacuum-deposited on both culture dishes and specimen carriers, silicon monoxide exhibited excellent optical, chemical, and heat-conducting properties and proved to be a good substrate for growth of a variety of fibroblastic and epithelial cell lines. Existing cytological techniques were therefore modified for use with silicon monoxide. These technical advances allowed examination of the biochemical properties and native morphology of cultured fibroblasts growing under the same conditions. Morphological studies showed that cellular interactions between Balb 3T3 fibroblasts could be divided into four classes: simple overlap, edge-to-edge contacts, interdigitation, and filopodial interactions. Freeze-fracture studies showed that neither the density nor the distribution of intramembranous particles appeared to be changed by cell contact, suggesting that if the membrane properties of cultured fibroblasts change as a result of density-dependent inhibition of growth, the changes may be reflected in an alteration of the mobility rather than the distribution of the IMP. Therefore, initial experiments were carried out using incubation in glycerol solutions as a means of inducing redistribution of the intramembranous particles. (ERB)

14265 (UCD—472-125, pp 97) **Production of jojoba wax in tissue culture.** Rost, T.L.; Lambert, C.; Wrightson, M.; Shifrine, M. Oct 1979.

In Annual report, 1978-1979.

This report covers a portion of a larger study dealing with the induction of wax synthesis in cultured jojoba cells, and is concerned with the production of callus and the morphogenetic and physiological changes which cotyledon segments undergo during the first thirty days in culture.

14266 (UCLA—12-1231) **Ultrastructural differentiation and synaptogenesis in aggregating rotation cultures of rat cerebral cells.** Lu, E.J.; Brown, W.J.; Cole, R.; de Vellis, J. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1979. Contract EY-76-C-03-0012. 35p. Dep. NTIS, PC A03/MF A01.

Cerebral cortices from fetal rats were dissociated into single cells by either trypsinization or mechanical sieving. Then the cells were allowed to form aggregates in rotation cultures. At 7, 14, 21, 28, and 35 days, aggregates were processed for electron microscopic study of morphological differentiation with special emphasis on synaptogenesis. Whether the tissue was initially dissociated by trypsin treatment or by mechanical sieving, the aggregating cultures did not exhibit any apparent differences in ultrastructural differentiation and synaptogenesis. At day 7, most neurons were immature and the extracellular space was large. Cell processes had not yet branched extensively but did contain numerous microtubules. A few immature synapses were observed. Astrocytes and oligodendrocytes displayed many of their typical cytological features. At day 14, dendritic spines had developed, some of which formed axodendritic spinous synapses. Multilayered myelin sheaths were tightly wrapped around axons. At day 21, synapses appeared mature and their number per unit area was maximal. The extracellular space had greatly decreased. At this age, asymmetrical synapses had increased approximately sixfold, whereas symmetrical synapses increased only fourfold when compared with the 7-day-old aggregates. Multifocal degeneration became apparent at 28 days and was accompanied by a significant decline in the number of synapses.

14267 (UCLA—12-1233) **Glial-released proteins in clonal cultures and their modulation by hydrocortisone.** Arenander, A.T.; de Vellis, J. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1979. Contract EY-76-C-03-0012. 53p. Dep. NTIS, PC A04/MF A01.

Rat glial C6 cells release into the culture medium a reproducible spectrum of soluble proteins of 12 major peaks over a broad molecular weight range as determined by fractionation on SDS-gel electrophoresis. Exposing C6 monolayers to hydrocortisone (HC) results in a selective alteration in the pattern of glial-released protein (GRP). The selective HC-induced increase or decrease in GRP peaks is specific to HC in that 17 β-estradiol, dibutyryl cyclic AMP, isoproterenol, and melatonin exert either no detectable or a qualitatively different influence on the GRP pattern. The HC influence is dose dependent over a physiological range of concentrations from 10^{-9} to 10^{-6} M. Differences in culture age and in subclones of C6 can influence both the normal and the HC-induced pattern of GRP. The origin of the GRP is unknown, but pattern reproducibility, viability tests, surface labelling studies, and metabolic labelling studies of soluble and particulate compartment proteins and glycoproteins support the position that cell lysis is not an important source of GRP. More importantly, these studies indicate that GRP and HC-induced changes in GRP pattern are physiologically significant aspects of glial cell behavior.

14268 (UCRL—83854) **Methods for human and murine sperm assays.** Wyrobek, A.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 33p. (CONF-800113—1). Dep. NTIS, PC A03/MF A01.

From Workshop on short term tests for chemical carcinogens; Vancouver, BC, Canada (Jan 1980).

Human sperm assays in the context of an epidemiological study provide an effective means to identify agents that affect testicular function. Four assays for human sperm anomaly (counts, motility, morphology, and double-fluorescence bodies) have been successfully used for a variety of human occupational and drug-related exposures. However, more research is needed to validate the genetic implications of sperm defects induced by exposure to chemicals in vivo. The F_0 and F_1 mouse-sperm assay, especially for induced morphological defects, provides a method of screening agents that may be potentially harmful to man and provides a means to assess the antifertility effects and consequences of induced sperm defect.

14269 **Neoplastic transformation and dose fractionation: does repair of damage play a role.** Elkind, M.M.; Han, A. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *Radiat. Res.;* **79**: No. 2, 233-240(Aug 1979).

From 26. annual scientific meeting of the Radiation Research Society; Toronto, Canada (18 May 1978).

The induction of neoplastically transformed cells has been measured with single and fractionated doses of 50-kV X rays and fission-spectrum neutrons from the Janus reactor at the Argonne National Laboratory. Combining these results with parallel measurements of cell survival permits an analysis of the possible roles of repair processes in the expression of sublethal and subtransformation damage. It is concluded that subtransformation damage due to X rays is repaired although probably more slowly than sublethal x-ray damage. Much less, if any, repair occurs between neutron doses for periods up to 24 h.

GENETICS

REFER ALSO TO CITATION(S) 14288

14270 (UR—3490-1790) **Studies of DNA repair in saccharomyces cerevisiae. I. Characterization of a new allele of RAD6. II. Investigation of events in the first cell cycle after DNA damage.** Douthwright-Fasse, J.A. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 136p. Dep. NTIS, PC A07/MF A01.

Thesis.

Studies in two independent, but related, areas of DNA repair have been carried out in Saccharomyces cerevisiae; characterization of a new allele in the RAD6 gene which suggests that the gene is multifunctional, and utilization of photoreactivation as a probe of events occurring during the first cell cycle after DNA damage. Strains carrying the new allele, designated rad6-4, are as sensitive to uv and ionizing radiation as those carrying rad6-1 or rad6-3 but, unlike them, are capable of induced mutagenesis and sporulation. Although rad6-4 may well be a missense mutation, the evidence shows that it is unlikely that this phenotype is due to leakiness. Instead, the data suggest that the RAD6 gene is multifunctional. One function is necessary to recover from DNA damage in an error-free manner, and the other is concerned with mutagenic processes and sporulation. Rad6-1 and rad6-3 strains are deficient in both of these functions, while rad6-4 strains are deficient only in the error-free function. The loss of photoreversibility (LOP) of ultraviolet induced mutations to arginine independence in an excision defective strain carrying arg4-17 examines the events occurring in the first cell cycle after DNA damage. LOP is dependent upon de novo protein synthesis. LOP begins immediately after UV irradiation, before semiconservative DNA synthesis takes place, and is complete after four hours in growth medium.There is no evidence indicating whether the normal function of the protein is involved in excision repair, or in one of the two repair processes believed to be inducible; induced mutagenesis or recombinational repair.

MEDICINE

REFER ALSO TO CITATION(S) 14331

14271 (LA—7990-PR) **Serologic test systems development. Progress report, October 1, 1977-September 30, 1978.** Seawright, G.L.; Bartlett, M.L.; Sanders, W.M.; Clinard, E.H.; Mills, K.W.; Martinez, A.; Payne, R.J.; Bishop, W.W.; Zimmerman, W.J. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 43p. Dep. NTIS, PC A03/MF A01.

Work has continued on the development and applicaion of the enzyme immunoassay (EIA) for the United States Department of Agriculture food animal disease control programs. A major effort was made this year to automate the enzyme immunoassay (EIA) using a modified Technicon Autoanalyzer II as the model system. With this system we have demonstrated the feasibility of totally automated EIAs with high throughput and the production of digitized, computer-compatible data. An evaluation of the automated EIA for the detection of swine trichinosis in a limited field trial with sera from slaughter pigs showed encouraging results. Development of an automated test for gentamicin was also initiated. Preliminary results with the gentamicin assay indicate that the automated EIA can be a rapid, sensitive, and inexpensive method for detecting low molecular weight environmental contaminants and residues in foodstuffs. Work is continuing to optimize the automated EIA for detecting swine trichinosis and gentamicin and for adapting it to the detection of other food-animal diseases and low molecular weight substances.

14272 (LBL—7448, pp 3-14) **Research medicine.** 1977.

In Biology and Medicine Division annual report, 1977.

A major effort of this program is in the field of quantitative radionuclide imaging. Four approaches to noninvasive evaluation of human biochemical and physiological states are used: positron tomography for three-dimensional quantitative imaging; computerized whole-body scanning of isotope distribution; expired air analysis of $^{14}CO_2$ from the metabolism of injected pharmaceuticals; and whole-body counting. This program is closely associated with the development of instrumentation and radiopharmaceuticals for radionuclide studies, and the investigative studies using them. Its major emphasis is to apply the efforts of new instrumentation and radiopharmaceuticals to medical problems such as brain and heart blood flow and metabolism resulting from various disease and environmental conditions. Kinetic analyses are made based on the conservation-of-mass equation and precise information of the sequential tissue concentrations by three-dimensional imaging. The technology being developed embodies the concept of in vivo biochemistry of amino acids, fatty acids, and glucose. This group continues its research effort in the hematology area. Currently studies of the megakaryocytic cell system are being carried out in an effort to understand platelet turnover and how the blood platelet count is regulated. This is important not only in a broad spectrum of blood disorders, but also in the evaluation of toxic environmental pollutants.

14273 (UCID—18225) **Development and evaluation of new stains and other optical markers useful for cytopathologic specimens in suspension. Tenth semi-annual progress report, 1 December 1978-30 June 1979.** Mayall, B.H.; King, E.B.; Jensen, R.H.; Dean, P.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jul 1979. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

The major part of our effort during this past reporting period has been engineering design, assembly, and testing of the Dual Beam, Computer Controlled Sorter. At the same time, double DNA staining and single DNA staining have continued to be studied. Specific achievements during the reporting period are: Redesign of the signal handling electronics in the DBS; Assembly of the redesigned electronics and installation into the DBS; Completion of the firmware installation of the ND-6660 for computer-controlled sorting; Addition of a video display to the LSI-11 sorter monitor; Three parameter analysis of cervical samples measuring log (chromomycin A3 fluorescence), log (orthogonal light scatter), log (Hoechst 33258 fluorescence); Three parameter analysis of cervical samples measuring log (chromomycin A3 fluorescence), log (orthogonal light scatter), log (SITS fluorescence); Analysis of the effect of DNase pretreatment on diagnostic power of flow cytometry measuring log (chromomycin A3 fluorescence) and log (orthogonal light scatter); Analysis of the diagnostic power of such flow cytometry on samples pooled separately from the ectocervix-endocervix and the vagina.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 14122, 14310, 14322, 14351, 14360

14274 (COO—4115-46) **Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.** Adelstein, S.J.; Brownell, G.L. (Massachusetts Inst. of Tech., Cambridge (USA); Children's Hospital Medical Center, Boston, MA (USA)). Apr 1979. Contract EY-76-S-02-4114. 144p. Dep. NTIS, PC A07/MF A01.

Individual projects are indexed separately. (PCS)

14275 (COO—4115-46, pp 6-12) **Chemistry of technetium related to nuclear medicine.** Jones, A.G.; Davison, A. Apr 1979.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.

The goal of this research program is to elucidate certain features of the chemistry of technetium which can be exploited in the design of radiopharmaceuticals labeled with the radionuclide Tc-99m. Studies of the interaction between the metal in various oxidation states and donor ligands which occur in biological systems have continued. Using the long-lived isotope Tc-99, compounds are being isolated in amounts suitable for characterization by conventional methods of analysis. Within, we report further progress in the identification of thiol complexes which incorporate technetium in the +5 oxidation state, and on parallel studies using its congener rhenium. Also included are investigations into more efficient methods of synthesizing these complexes in aqueous media, and further electrochemical studies on a number of coordination compounds containing technetium.

14276 (COO—4115-46, pp 14-28) **Synthesis and evaluation of agents for imaging the myocardium.** Apr 1979.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.

The aim of this proposal is to synthesize radiopharmaceuticals which selectively localize in either the infarcted or the normal myocardium and to evaluate them in animals for detecting, sizing, and localizing acute infarction with external detection systems. The goals for this reporting period included: (a) biologic evaluation of ^{197}Hg-hydroxymercurifluorescein and ^{197}Hg-bis(hydroxymercuri-)-phenolsulfonophthalein; (b) preparation of ^{99}Tc labeled fluorescein derivatives and (c) further evaluation of the radioiodinated beta adrenergic antagonists in the heat lesioned rat heart model.

14277 (COO—4115-46, pp 29-38) **^{75}Se-radiodiagnostics for external visualization of pancreas and adrenals.** Apr 1979.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.

The goal of this proposal is the synthesis of selenium containing analogs of the aromatic amino acids as limiting agents for the pancreas and of the adrenal cortex enzyme inhibitors for imaging adrenal pathology. The work done for this year included: (a) the synthesis of methylseleno derivatives of phenylalanine and tryptophan; (b) the synthesis and biodistribution of ^{75}Se-1, 2, 3 selenadiazole analogs of metrapo and SU-9055; and (c) the synthesis and testing in animals of the ^{125}I-iodobenzoyl derivatives of the aminoselenazole analogs of metyrapone and SU-9055.

14278 (LBL—7448, pp 37-60) **Radiation biophysics.** 1977.

In Biology and Medicine Division annual report, 1977.

This group is studying applications of accelerated heavy ions in biology, medicine, and health protection, with particular emphasis on radiation therapy of cancer. Beams of carbon, neon, and argon nuclei are accelerated up to 90% of the speed of light using the Bevalac, a combination of the SuperHILAC and the Bevatron. The nuclear physics of high-energy heavy ions is just beginning. Heavy ions are expected to improve significantly the ratio of tumor dose to normal tissue dose, and investigators are systematically studying the physical, chemical, and biological characteristics of heavy-particle beams so that radiotherapists will have the information required to select the most appropriate heavy particle beam to achieve maximum benefit in a specific therapeutic situation.

14279 (NTISUB/E/294—017) **Preclinical radiologic diagnosis and radiotherapy of cancer. Special listing.** (National Cancer Inst., Bethesda, MD (USA). International Cancer Research Data Bank). 27 Jul 1979. 71p. NTIS, PC A04/MF A01.

The Special Listing of Current Cancer Research Projects is a publication of the International Cancer Research Data Bank (ICRDB) Program of the National Cancer Institute. Each Listing contains descriptions of ongoing projects in one selected cancer research area. Approximately 50 different cancer research areas are covered by a separate Special Listing. The research areas include: Diagnosis of cancer by x-radiography; Use of radioisotopes in the diagnosis of cancer--isotope preparation, scanning equipment, and methodology; Radioisotope scintigraphy of cancer; New methods with potential for the radiologic diagnosis of cancer; X-ray, radioisotope, heavy particle, hyperthermia, and other radiation therapy of cancer; Combinations of radiotherapy with chemotherapy, hormone therapy, or immunotherapy; Radiation dosimetry and dose fractionation studies; Effect of radiotherapy on non-target tissues and on host immunity; New techniques and equipment for cancer radiotherapy; Computer-assisted treatment planning of cancer radiotherapy; Special radiotherapy agents and procedures.

14280 (PB—297243) **Operation of pneumococcal polysaccharide radioimmunoassay reference laboratory; coordination of the serological aspects of otitis media field trials. Annual report 28 Jun 77—27 Jun 78.** Schiffman, G. (State Univ. of New York Downstate Medical Center, Brooklyn (USA). Dept. of Microbiology and Immunology). 3 Apr 1978. Contract N01-AI-4-2541. 16p. NTIS, PC A02/MF A01.

The contract supports a serologic reference laboratory for the performance of radioimmunoassay of antibodies to pneumococcal polysaccharides. Antibody assays have been performed for a number of investigators studying the response of humans to pneumococcal vaccines. In addition, a large quantity of labeled polysaccharides for use in the assay have been prepared and stored.

14281 (UCD—472-125, pp 22-25) **Cyclotron target system for the synthesis of ^{13}N labeled ammonia, dinitrogen, nitrite and nitrate.** Parks, N.J.; Krohn, K.A. Oct 1979.

In Annual report, 1978-1979.

The utility of radioactive ^{13}N(T/sub 1/2/ = 10 min) as a tracer in environmental studies is well recognized. In our laboratory, labeled ammonium ion solutions with ^{13}N radioactivity concentrations > 20 μCi mm^{-3} were required for in vivo measurements of hygroscopic aerosol growth phenomena. This report describes a cyclotron target system that was fabricated for production of biologically useful quantities of $^{13}NH_4^+$, as well as $^{13}N^{14}N$, $^{13}NO_2^-$, and $^{13}NO_3^-$.

14282 (UCLA—12-1230) **Regional myocardial blood flow, metabolism and function assessed noninvasively by positron emission tomography.** Schelbert, H.R.; Phelps, M.E.; Hoffman, E.; Huang, S.; Kuhl, D.E. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology; California Univ., Los Angeles (USA). School of Medicine). 1979. Contract EY-76-C-03-0012. 24p. Dep. NTIS, PC A02/MF A01.

Positron emission computed tomography is a new technique for the noninvasive measure of myocardial blood flow, mechanical function and, in particular, metabolism. The capability of this new study means is due to the technological innovations of the imaging device and the availability of radioactive tracers that are specific for blood flow and metabolism. The device permits recording of cross-sectional images of the left ventricular myocardium that reflect quantitatively regional tracer tissue concentrations. By employing tracer kinetic models this new technique permits the measurement of regional glucose and fatty acid metabolism of the heart. While already an important new tool for investigative studies into cardiac physiology and pathophysiology, the clinical utility of positron emission tomography remains to be defined.

EXTERNAL RADIATION IN DIAGNOSTICS

14283 (COO—4115-46, pp 44-56) **Investigation of the use of ^{178}Ta in nuclear medicine.** Davis, M.A.; Neirinckx, R.D. (Children's Hospital Medical Center, Boston, MA). Apr 1979.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.

The aim of this project is to examine the practicality of the ^{178}W-^{178}Ta generator for nuclear medicine. In the past year large generators, (up to 200 mCi) have been built and operated successfully. Several particulate agents for lung and liver imaging have been labeled to ^{178}Ta using procedures that take less than one half-life of the isotope. High activity (more than 100mCi) generators have been subjected to toxicity studies and were proven to be safe.

14284 (COO—4115-46, pp 57-74) **^{68}Ge-^{68}Ga generator.** Davis, M.S.; Neirinckx, R.D.; Elmaleh, D.H. (Children's Hospital Medical Center, Boston, MA). Apr 1979.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.

The aim of this project is to develop a chromatographic generator for ionic ^{68}Ga. In the past year organic ion exchanges and synthetic chelate resins have been successfully tested for their ability to separate germanium and gallium and experiments to determine their acceptability as generator supports have been started.

EXTERNAL RADIATION IN THERAPY

REFER ALSO TO CITATION(S) 14278, 14279, 14523

UNSEALED RADIONUCLIDES IN THERAPY

REFER ALSO TO CITATION(S) 14360

MICROBIOLOGY

REFER ALSO TO CITATION(S) 14255, 14270, 14288

14285 **Diphytanyl and dibiphytanyl glycerol ether lipids of methanogenic archaebacteria.** Tornabene, T.G. (Colorado State Univ., Fort Collins); Langworthy, T.A. *Science;* **203**: No. 4375, 51-53(5 Jan 1979).

The lipids of nine different methanogenic bacterial strains are comprised of diphytanyl glycerol diethers, previously known only in

extremely halophilic bacteria, as well as dibiphytanyl diglycerol tetraethers, known formerly only in the extremely thermoacidophilic bacteria Thermoplasma and Sulfolobus. Of the methanogens examined from four representative taxonomic groups, Methanobacterium and Methanospirillum contained both types of isopranyl ethers in nearly equal proportions, whereas the coccal forms, Methanosarcina and Methanococcus, possessed diphytanyl glycerol diethers, but with only a trace of or no dibiphytanyl diglycerol tetraethers. The occurrence of both types of isopranyl glycerol ethers in methanogenic bacteria supports the proposal that they have a close genealogical relationship to the extremely halophilic and thermoacidophilic bacteria.

MORPHOLOGY

REFER ALSO TO CITATION(S) 14260, 14266, 14383

PATHOLOGY

REFER ALSO TO CITATION(S) 14298, 14346

14286 (LBL—7448, pp 21-22) **Peralta Cancer Research Institute.** 1977.

In Biology and Medicine Division annual report, 1977.

PCRI's first research program is concerned with developing techniques for early diagnosis of breast cancer and studying the biology of breast cancer cells, with the hope of developing improved therapeutic methods. Since the program's initiation, over 2000 women have been studied, and early cancers have been detected in three women. In three other instances, lesions likely to become cancerous were detected and the women's physicians were alerted. These tumors were removed with only minor surgery. The program of the Cell Culture Studies Group investigates the growth properties, nutritional requirement, and hormone responsiveness of malignant cells and compares them with normal cells for development of new therapy protocols.

14287 (UCD—472-125, pp 90-94) **Granulopoietic effects of fibroblastic colonies in normal humans and in patients with acute myelogenous leukemia and myeloproliferative disorders.** Greenberg, B.R.; Wilson, F.D.; Woo, L. Oct 1979.

In Annual report, 1978-1979.

The granulopoietic effects of fibroblastic colonies on CFU-C were studied in vitro in normal humans and in patients with acute myelogenous leukemia (AML) and myeloproliferative disorders. To determine their influence on granulopoiesis we obtained FC in liquid culture from normals and patients with AML, pre-leukemia, myeloproliferative disorders (MPD) and metastic carcinoma and overlaid them with normal and leukemic human marrow cells in agar measuring the number of CFU-C. Increased numbers of CFU-C were found above the FC obtained from normals with no growth greater than control in those areas lacking FC. FC obtained from untreated AML failed to enhance granulopoiesis in contrast to the stimulation produced by FC from AML in remission. FC from patients with MPD had little effect on granulopoiesis. Occasional normal appearing colonies were observed when leukemic target cells were used in the overlay. The addition of FC to placenta conditioned media never augmented granulopoiesis further and frequently was inhibitory. The supernatant from normal FC had a minimal effect on colony growth and when obtained from patients with pre-leukemia and untreated AML, no effect was noted. These studies indicate that FC were capable of enhancing granulopoiesis and in AML marked differences are observed depending on the status of the disease. Furthermore, the effects of FC on granulopoiesis appear to be local, are not synergistic with colony stimulating activity for the total number of colonies but are synergistic for colony size. The interaction of cells of stromal origin witl. hematopoietic progenitors may be important in the clinical expression of hematological malignancies.

14288 (UCLA—12-1234) **Leukemia accelerating (LAc) properties of retroviruses in AKR, SJL and CBA/H mice.** Hays, E.F. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). 1979. Contract EY-76-C-03-0012. 18p. Dep. NTIS, PC A02/MF A01.

Retrovirus expression was studied in eight spontaneous lymphomas of SJL mice. We showed that viruses were present in all of the tumors; some N-tropic, some B-tropic and, in one instance, xenotropic viruses were found. Two of these virus preparations accelerated thymic lymphoma after inoculation of neonatal SJL mice. Cells from normal lymphohemopoietic tissues of 6-week-old AKR, SJL, and CBA/H mice were also evaluated for retrovirus expression. Viruses were found in all AKR and SJL tissues but not in those from CBA/H mice. In additional experiments, four AKR-derived viruses which were leukemia accelerating for AKR mice were tested by inoculation into neonatal SJL and CBA/H mice. Two of the virus preparations were associated with the development of early thymic lymphomas in SJL mice. None were lymphomagenic for mice of the CBA/H strain. We have proposed that genetic regulation of host immune response to viral proteins may explain these findings.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 14260, 14267, 14268

14289 (FDA—79-8042, pp 73-77) **General linear analysis of serum cholesterol levels in euthyroid and hypothyroid 5-year-old beagles.** Stephens, L.C.; Angleton, G.M.; Norrdin, R.W. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

The differential aspects of serum cholesterol values in 140 5-year-old euthyroid and hypothyroid beagles were studied using the CRHL General Linear Model Analysis Program. The analysis was conducted in a manner that allowed taking into account effects attributable to sex, body weight, and whether the thyroid had lesions of focal hyperplasia. Significant effects related to the preceding variables were noted.

14290 (UCD—472-125, pp 87-89) **Morphological studies on attaching cells in bone marrow cultures obtained from humans, canines and mice.** Wilson, F.D.; Tavassoli, M.; Greenberg, B.R.; Hinds, D. Oct 1979.

In Annual report, 1978-1979.

The results of scanning electron microscopic studies on attaching cells obtained from cultures of bone marrow from humans, dogs and mice are presented. The morphology of these cells was similar in humans and dogs but differed from mice. These cells in humans and dogs were morphologically much more homogeneous, more tightly attached or flattened than in mice. The relationship of these observations to previous studies on attaching cells is discussed.

14291 (UR—3490-1787) **Modification of sodium and potassium channel kinetics by diethyl ether and studies on sodium channel inactivation in the crayfish giant axon membrane.** Bean, B.P. (Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics). 1979. Contract EY-76-C-02-3490. 214p. Dep. NTIS, PC A10/MF A01.

Thesis.

The effects of ether and halothane on membrane currents in the voltage clamped crayfish giant axon membrane were investigated. Concentrations of ether up to 300 mM and of halothane up to 32 mM had no effect on resting potential or leakage conductance. Ether and halothane reduced the size of sodium currents without changing the voltage dependence of the peak currents or their reversal potential. Ether and halothane also produced a reversible, dose-dependent speeding of sodium current decay at all membrane potentials. Ether reduced the time constants for inactivation, and also shifted the midpoint of the steady-state inactivation curve in the hyperpolarizing direction. Potassium currents were smaller with ether present, with no change in the voltage dependence of steady-state currents. The activation of potassium channels was faster with ether present. There was no apparent change in the capacitance of the crayfish giant axon membrane with ether concentrations of up to 100 mM. Experiments on sodium channel inactivation kinetics were performed using 4-aminopyridine to block potassium currents. Sodium currents decayed with a time course generally fit well by a single exponential. The time constant of decay was a steep function of voltage, especially in the negative resistance region of the peak current vs voltage relation.The time course of inactivation was very similar to that of the decay of the current at the same potential. The measurement of steady-state inactivation curves with different test pulses showed no shifts along the voltage asix. The voltage-dependence of the integral of sodium conductance was measured to test models of sodium channel inactivation in which channels must open before inactivating; the results appear inconsistent with some of the simplest cases of such models.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 14282

14292 (COO—4115-46, pp 39-43) **Ultrashort-lived radionuclide generator systems for angiocardiography.** Treves, S.; Davis, M.A.; Neirinckx, R.D. (Children's Hospital Medical Center, Boston, MA). Apr 1979.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.

Radionuclide angiography serves as a method of evaluating cardiovascular dynamics. In pediatric medicine it is particularly useful in diagnosing and quantifying intracardiac shunts. The most

commonly used radionuclide at present is /sup 99m/Tc (T/sub 1/2/ = 6.0 hours), but because the recording period for a typical study is approximately 20 seconds, this means that the patient is irradiated for a longer period than is necessary. This investigation is aimed at the development of a radionuclide generator for /sup 191m/IR (t/sub 1/2/ = 5 sec; E/sub γ/ = 129 keV), formed in the decay of the parent ^{191}Os (t/sub 1/2/ = 15.3 days). In this progress report we announce an improved chromatography separation which yields /sup 191m/IR in an eluting solution of isotonic saline at pH 7.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 13213, 13217, 13218, 13225, 13296, 13297, 13504, 13519, 14271

14293 (PB—295531) **Environmental planning manual for salinity management in irrigated agriculture. Final report, 22 August 1976-31 August 1978.** Skogerboe, G.V.; Walker, W.R.; Evans, R.G. (Colorado State Univ., Fort Collins (USA). Dept. of Agricultural and Chemical Engineering). Mar 1979. 250p. NTIS PC A11/MF A01.

An Environmental Planning Manual for Salinity Management in Irrigated Agriculture has been prepared. The primary focus of this manual is a delineation of the combinations of technological and institutional solutions, the various levels of planning effort, use of existing data and necessary field investigations which are required for the different planning levels, methods of data analysis, technological and socioeconomic considerations in implementing a salinity control program, and finally, recommendations for formulating an action program. It is intended that the primary audience for this manual would be environmental planners such as EPA Regional Offices, state water pollution control agencies, regional councils of governments, and 208 planning groups. In addition, it is intended to serve as a guide to be used and tailored at the discretion and guidance of the supervisory personnel to persons without prior training or experience in assessing the nonpoint source pollution problems of irrigation return flows due to salinity.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 14220

BIOMEDICAL SCIENCES, APPLIED STUDIES

14294 (UCD—472-125) **Annual report, 1978-1979.** (California Univ., Davis (USA). Radiobiology Lab.). Oct 1979. Contract EY-76-C-03-0472. 260p. Dep. NTIS, PC A12/MF A01.

Research efforts are directed toward contributing pertinent knowledge for safe and effective utilization of energy in our society. Our research program emphasizes research on mechanisms of effects and quantification of possible late effects from low-level exposure to radiation or from other agents by the use of appropriate biologic test systems. Our interest includes the measurement of exposure and dose and delineation of their possible relationships to health consequences, such as tumors and shortening of lifespan. The effects of exposure in sensitive systems, which include the hematopoietic tissues, gonads, bone, lung, thyroid, and liver, are of particular interest. Basic studies on relevant primary metabolic mechanisms are included. The mission of the Laboratory includes, as an important aspect, the definition of sensitive segments of the test population and the more sensitive of tissue systems within individuals. Appropriate utilization of animal models provides a valid basis for extrapolating information derived in the Laboratory toward the goal of achieving more effective protection for man. Studies on mechanisms and assessment of affects employ a multidisciplinary approach and include expertise in molecular biology, biophysics, physiology, cellular biology, immunology, toxicology, oncology, radiologic dosimetry, analytical chemistry, and biochemistry. These studies assist in the evaluation of long-term, low-level effects by use of either simulated or real emissions from single or multiple sources of nuclear or fossil fuel energy-related pollutants.

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

REFER ALSO TO CITATION(S) 14297

IN MICROORGANISMS

REFER ALSO TO CITATION(S) 14270, 14304

14295 (COO—3501-13) **Biological effects of ionizing radiation at the molecular, cellular and organismal levels. Annual progress report, October 15, 1978-October 14, 1979.** Lange, C.S. (Rochester Univ., NY (USA). School of Medicine and Dentistry). 1979. Contract EY-76-S-02-3501. 13p. Dep. NTIS, PC A02/MF A01.

The Zimm theory of rotor speed dependent DNA sedimentation has been tested quantitatively and found to be correct as predicted by the equation of Zimm and Schumaker. The quantitative validity of the theory means that the size of a DNA sedimenting under speed-dependent conditions is not undefinable but rather can be uniquely obtained by the application of that theory to the data. The viscoelastic recoil or more accurately, the zero shear rate reduced recoil has been shown to be a quantitative direct function of the number of intact DNA molecules present in solution. This demonstration made possible the measurement of a direct survival curve for intact DNA molecules after exposure to ionizing radiation. A D_{37} of 49.5 krads was obtained for the DNA of T4c coliphage irradiated as a solution of phage particles. It is noteworthy that this survival curve measures the number of intact DNA molecules, not the average number of breaks/molecule.

IN ANIMALS

14296 (UCD—472-125, pp 101-103) **Whole blood technique for the in vitro growth of con-A stimulated colonies.** Dyck, J.; Wilson, F.D.; Shifrine, M.; Knox, S.; Taylor, N.J. Oct 1979.

In Annual report, 1978-1979.

A whole blood technique for the cloning of canine T-lymphocytes in semisolid media is described. By eliminating the routine Ficoll-Paque lymphocyte isolation, this method avoids questions concerning possible growth modulating or selective effects of Ficoll-Paque and more closely approximates the in vivo milieu. Mitogen titration data indicates that a relatively large dose of concanavalin-A is required for whole blood colony formation compared to the standard Ficoll-Paque method.

14297 (UCD—472-125, pp 105) **Effect of chronic low level radiation on lectin-induced lymphocyte transformation.** Shifrine, M.; Taylor, N.J.; Wilson, F.D.; Wiger, N.; DeRock, E.W. Oct 1979.

In Annual report, 1978-1979.

As part of a comprehensive study of the effect of chronic irradiation on leukemogenesis, we have assessed the immune status of dogs subjected to such irradiation. For this purpose, we found that the whole blood lymphocyte stimulation test (WB/LST) was a more sensitive test and required much less blood. Radioresistant populations were observed. PHA-stimulated lymphocytes showed a profound reduction in response whereas the con-A-stimulated lymphocytes did not exhibit any changes. In dogs showing severe aplastic anemia, the con-A-stimulated lymphocytes were also affected. This dichotomy of immunologic response provides a radionale to explain radiation survival of specific individuals.

IN MAN

14298 (LBL—7448, pp 15-19) **Donner Pavilion.** 1977.

In Biology and Medicine Division annual report, 1977.

Ongoing work continues to assess the effectiveness and consequences of alpha particle pituitary irradiation (APPI) as therapy of pituitary tumors, and to evaluate the long-term effects of APPI on the vascular complications of patients with diabetes mellitus. In addition, an understanding of the endocrine pathology associated with tumors of the pituitary is being sought by evaluating the molecular changes (heterogeneity) in pituitary peptide hormones and the influence of hypothalamic releasing factors. An investigation of somatomedins in patients with pituitary tumors has been started with the development of a radioimmunoassay of human beta-lipotropin, a pituitary hormone which hitherto had been poorly understood.

14299 (UCD—472-125, pp 104) **Use of lectin-induced lymphocyte stimulation as a biodosimeter of radiation damage.** Shifrine, M.; Taylor, N.J.; DeRock, E.W.; Wiger, N.; Wilson, F.D. Oct 1979.

In Annual report, 1978-1979.

The purpose of this study was to determine the feasibility of utilizing an in vitro test to determine whether an individual has suffered radiation damage. It was not our purpose to develop a test capable of detecting low doses but rather to determine possible damage due to a radiation accident at medium to high doses. In a pilot study using the whole blood lymphocyte stimulation test (WB/LST), we pretested six dogs weekly for three weeks. One was sham irradiated and is referred to as the control and one each received an acute whole body dose of 10, 25, 50, 75, or 100 R. The dogs were tested one day post-irradiation and then weekly for 56 days. Our data indicate that, using Con-A and PHA in the WB/LST, a biodosimeter can be developed to determine recovery of lymphocyte function after suspected radiation exposure to confirm accidental radiation and estimate the magnitude of the dose.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 14269, 14304, 14306, 14336, 14340, 14341

14300 (BNL—26958) **DNA repair in mammalian cells exposed to combinations of carcinogenic agents.** Setlow, R.B.; Ahmed, F.E. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 24p. (CONF-791161—1). Dep. NTIS, PC A02/MF A01.

From 10. international symposium of the Princess Takamatsu cancer research fund; Tokyo, Japan (13 Nov 1979).

Cells defective in one or more aspects of repair are killed and often mutagenized more readily than normal cells by DNA damaging agents, and humans whose cells are deficient in repair are at an increased carcinogenic risk compared to normal individuals. The excision repair of uv induced pyrimidine dimers is a well studied system, but the details of the steps in this repair system are far from being understood in human cells. We know that there are a number of chemicals that mimic uv in that normal human cells repair DNA damage from both these agents and from uv by a long patch excision repair system, and that xeroderma pigmentosum cells defective in repair of uv are also defective in the repair of damage from these chemicals. The chemicals we have investigated are AAAF, 4-NQO, DMBA-epoxide, and ICR-170. We describe experiments, using several techniques, in which DNA excision repair is measured after treatment of various human cell strains with combinations of uv and these agents. If two agents have a common rate limiting step then, at doses high enough to saturate the repair system, one would expect the observed repair after a treatment with a combination of agents to be equal to that from one agent alone. Such is not the case for normal human or excision-deficient XP cells. In the former repair is additive and in the latter repair is usually appreciably less than that observed with either agent alone. Models that attempt to explain these surprising results involve complexes of enzymes and cofactors.

14301 **Photoenzymatic repair of ultraviolet-irradiated DNA in the cells of a shark, Prionace glauca.** Woodhead, A.D.; Achey, P.; Setlow, R.B.; Grist, E. (Brookhaven National Lab., Upton, NY (USA)). *Comp. Biochem. Physiol.;* **60**: No. 3, 205-208(1978).

Cells from several tissues of the blue shark have been tested for the presence of photoreactivating enzyme using a sensitive assay requiring only 250 ng of DNA. Photoactivating enzyme was found to be present in thyroid, liver, brain and kidney cells. There has been much debate concerning the significance of the reported distribution of photoreactivating enzyme in animal tissues, but the information available is too limited for generalizations to be made. It is suggested that the present assay might allow rapid and easy survey of a wide spectrum of organisms.

14302 (UCD—472-125, pp 98-99) **Inhibition of cell mediated immune responses by copper, ceruloplasmin and oral contraceptives.** Shifrine, M.; Fisher, G.L.; Taylor, N.J.; DeRock, E.W.; Wiger, N.; Wilson, F.D.; Knox, S. Oct 1979.

In Annual report, 1978-1979.

We have shown that free copper inhibited lymphocyte transformation in the whole blood lymphocyte cultures. Ceruloplasmin also inhibited lymphocyte transformation in the above tests as well as another test involving purified protein derivative from Mycobacterium tuberculosis. Women on oral contraceptives have elevated serum copper and ceruloplasmin levels, as do cancer patients. We hypothesize that women on oral contraceptives may have decreased cell mediated immune responses and may thus be at higher risk for cancer induction.

14303 **Repair of radiation-induced DNA double-strand breaks in isolated nuclei of Physarum polycephalum.** Brewer, E.N. (Case Western Reserve Univ., Cleveland, OH). *Radiat. Res.;* **79**: No. 2, 368-376(Aug 1979).

Radiation-induced DNA double-strand breaks are rejoined in homogenates and isolated nuclei of Physarum polycephalum. In agreement with results obtained previously for intact plasmodia, double-strand breaks are less extensively repaired in nuclei isolated from S-phase, as compared to G_2-phase, cultures. A corresponding propensity of DNA present in unirradiated nuclei of S-phase plasmodia toward breakage during incubation in vitro was observed. Repair of putative single-strand breaks, as ascertained from alkaline sucrose density-gradient centrifugation analysis, was not observed. The possible relationships between these phenomena are discussed.

INTERNAL SOURCE

REFER ALSO TO CITATION(S) 14296, 14299, 14334, 14335, 14337, 14338, 14339, 14365

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

REFER ALSO TO CITATION(S) 14270, 14295

14304 (CONF-790229—4) **Oxygen-dependent sensitization of irradiated cells.** Ewing, D.; Powers, E.L. (Hahnemann Medical Coll. and Hospital, Philadelphia, PA (USA); Texas Univ., Austin (USA). Lab. of Radiation Biology). 1979. Contract EY-76-S-05-3408. 64p. Dep. NTIS, PC A04/MF A01.

From 32. annual symposium on fundamental cancer research; Houston, TX, USA (27 Feb 1979).

Attention is focused primarily on O_2 effects in three biological systems, all tested in suspension: bacterial spores, vegetative bacterial cells, and mammalian cells. Information from these systems shows that O_2 has more than one process through which it can act. Studies with bacterial spore suspensions provide clear evidence that multiple components to oxygen-dependent radiation sensitization exist. Studies with mammalian cell suspensions also show that at least two oxygen-dependent sensitization processes can be distinguished. Similar studies with vegetative bacteria in suspension have not resolved oxic sensitization into components. The roles of water-derived radicals in radiation sensitivity and, specifically, in sensitization by O_2 were examined. OH radicals are clearly implicated in damage in all three biological test systems. However, the specific roles proposed for OH radicals are different in these organisms. In bacterial spores, OH radical removal in itself does not protect in anoxia or in high concentrations of O_2. OH radical removal over a limited intermediate range of O_2 concentrations will, however, protect. OH radical scavenging probably results in the formation of the actual protector. In bacteria, the supposition is that OH radical removal will protect both in anoxia and in the presence of O_2. OH radicals probably react with a cellular target molecule and leave a radicalsite; this is the site which can then react with O_2 to cause damage; DNA is the likely cellular target. In mammalian cells, a reaction scheme, similar to that proposed for bacteria, has been suggested for O_2-dependent sensitization. (ERB)

14305 (COO—2814-5) **Molecular basis for the mutagenic and lethal effects of ultraviolet irradiation. Research accomplishments (1968 to present).** Grossman, L. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Biochemistry). 1978. Contract EY-76-S-02-2814. 13p. Dep. NTIS, PC A02/MF A01.

Earlier work on the chemical basis of mutagenesis led to certain chemical generalities sufficient to explain how certain mutagens such as uv light and hydroxylamine functioned in information transfer systems (replicative, transcriptive and translational). When such modifications were applied to biologically active DNA in a controlled manner biological expression was non-stoichiometric because much of the damage was removed from the DNA by repair systems. Our efforts were then directed to these systems which led to: (1) the isolation, purification and characterization of endonucleases responsible for the first and controlling step in DNA repair - referred to as incision in both M. luteus and E. coli. The biological role of these enzymes was inferred in appropriate mutants; (2) the isolation, purification and characterization of exonucleases responsible for the removal or excision of damaged nucleotides in M. luteus and human placental trophoblasts; (3) the repair of uv damaged biologically active transforming and transfecting DNAs by purified endonucleases, exonucleases, DNA polymerase I and polynucleotide ligase from M. luteus and E. coli; (4) the characterization of the dual gene control for incision phenomenon in M. luteus and E. coli; and (5) isolation, purification and characterization of repair enzymes from human placenta (currently in progress).

14306 (PNL—2850(Pt.4), pp 2.21-2.35) **Radiation dosimetry and radiation biophysics.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Radiation dosimetry and radiation biophysics are two closely integrated programs whose joint purpose is to explore the connections between the primary physical events produced by radiation and their biological consequences in cellular systems. The radiation dosimetry program includes the theoretical description of primary events and their connection with the observable biological effects. This program also is concerned with design and measurement of those physical parameters used in the theory or to support biological experiments. The radiation biophysics program tests and makes use of the theoretical developments for experimental design. Also, this program provides information for further theoretical development through experiments on cellular systems.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 13141, 14223, 14298, 14305, 14523

14307 (N—79-26276) **Radiation safety in the use of color television sets. Problemi di radioprotezione nell impiego di televisori a colori.** Calicchia, A.; Panigutti, A.; Rosati, A. (Istituto Superiore di Sanita, Rome (Italy). Lab. della Radiazioni). 20 May 1977. 20p. NTIS, PC A02/MF A01.

The safety of color television sets was investigated using F2Cd thermoluminescent dosimeters. Measured results at 5 cm from the color television set show less than 1/30 of the maximum limit as set by Italian law, that is 0.5 mR/h. Problems specific to personnel who work daily in close contact with color television sets were not considered.

14308 (PB—296149) **Considerations for control of radiation exposures to personnel from shipments of radioactive materials on passenger aircraft.** (Office of Radiation Programs, Washington, DC (USA). Technology Assessment Div.). Dec 1974. 44p. NTIS PC A03/MF A01.

It is the purpose of this report to consider radiation protection factors for shipment of radioactive materials on aircraft and to provide recommendations for the radiological protection of passengers. The analysis considers costs and effectiveness of various protection measures in order that the most efficacious balance can be gained between the medical benefits of these materials and exposure of the air-traveling public.

VERTEBRATES

REFER ALSO TO CITATION(S) 14227, 14272, 14353, 14386

14309 (COO—119-254, pp 127-134) **Two new animal models for actinide toxicity studies.** Taylor, G.N.; Gardner, P.A.; Jones, C.W.; Lloyd, R.D.; Mays, C.W. 31 Mar 1979.

In Research in radiobiology. Annual report of work in progress in the internal irradiation program.

Two small rodent species, the grasshopper mouse (Onychomys leucogaster) and the deer mouse (Peromyscus maniculatus) have tenacious retention in the liver and skeleton of plutonium and americium. The retention following intraperitoneal injection of Pu and Am in citrate solution ranged from 20 to 47% (liver) and 19 to 42% (skeleton), relatively independent of post-injection times, varying from 30 to 125 days. Based on observations extended to 125 days post-injection, the biological half-times appeared to be long. Both of these rodents are relatively long-lived (median lifespans of approximately 1400 days), breed well in captivity, and adapt suitably to laboratory conditions. It is suggested that these two species of mice, in which plutonium is partitioned between the skeleton and liver in a manner similar to that of man, may be useful animal models for actinide toxicity studies.

14310 (COO—4115-46, pp 83-133) **Labeling of complex molecules with ^{18}F, ^{13}N, and ^{11}C.** Brownell, G.L.; Elmaleh, D. (Massachusetts General Hospital, Boston). Apr 1979.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.

The overall objective during the period covered by this report was to develop expertise in the production of a broad spectrum of radiopharmaceuticals labeled with short-lived cyclotron and generator-produced positron emitters, ^{11}C, ^{13}N, ^{18}F, and ^{68}Ga. The initial goals of the program were: (1) To develop the enzymatic synthesis of ^{13}N-glutamate and to evaluate its importance as an imaging agent for the myocardium. (2) To develop new syntheses of other compounds labeled with ^{13}N such as ^{13}N-L-asparagine by chemical method and evaluate its usefulness. (3) To develop ^{11}C-radiopharmaceuticals by using $^{11}CH_3I$ and $^{11}CH_2O$ for the syntheses of new groups of agents such as ^{11}C-α-methylthiopalmitate, and ^{11}C-16-methylthiopalmitate for the myocardium. ^{11}C-thebaeine, ^{11}C-morphine, and ^{11}C-ketobemedone for evaluation of their distribution and metabolism in the CNS. (4) To complete the development of the ^{18}F-target and evaluate the usefulness of $^{11}F^-$ as a bone and myocardial infarction scanning agent with the MGH positron camera. (5) To use anhydrous $^{18}F^-$ for labeling molecules such as 3-^{18}FDG, and for future use with 2-^{18}FDG.

14311 (FDA—79-8042) **CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.** Benjamin, S.A. (Colorado State Univ., Fort Collins (USA). Collaborative Radiological Health Lab.). Aug 1979. 144p. GPO.

The Collaborative Radiological Health Laboratory was established in 1962 by the Division of Biological Effects, BRH (then part of USPHS), and the Department of Radiology and Radiation Biology, Colorado State University, to assess possible long-term effects in the beagle from low-level whole-body gamma irradiation. The first section of this annual report summarizes the current status of the long-term effects of irradiation during development in the beagle. The second section addresses studies of radiation-induced and spontaneous disease in the beagle. Cardiovascular disease has also been noted to be a significant clinical disease problem in the aging beagle. The third section describes the CRHL data processing system as it existed and the current changes being made. Several aspects of the methods and procedures available for statistical analysis of data are discussed. Also documented is the current feeding practices for the CRHL beagle colony.

14312 (FDA—79-8042, pp 7-10) **Cumulative mortality statistics for Segment III beagles of the CRHL Long-Term Study.** Angleton, G.M.; Benjamin, S.A. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Tables for cumulative mortality statistics for Segment III beagles of the CRHL Long-Term Study are presented. No effects because of irradiation appear to be manifested in the mortality data available at this stage of the study. The statistics for the cumulative probabilities of survival for beagles entered into the Segment III of the CRHL Long-Term Study continue to be evaluated relative to testing null hypotheses on the existence of irradiation effects.

14313 (FDA—79-8042, pp 11-20) **Principal disease or cause of death in nonsacrifice Segment III beagles receiving gamma radiation during development.** Hargis, A.M.; Lovering, S.L.; Benjamin, S.A.; Thomassen, R.W.; Lee, A.C.; Brewster, R.D.; Brooks, R.K. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Epilepsy, hypothyroidism, neoplasia, and cor pulmonale remain the leading causes of death in Segment III beagles. This past year neoplasia became the third leading cause of death with the addition of 10 animals in this category. Of the four leading causes of death, neoplasia alone can be related to history of irradiation.

14314 (FDA—79-8042, pp 21-23) **Long-term Segment III beagles scheduled for sacrifice: a progress report.** Hargis, A.M.; Lovering, S.L.; Benjamin, S.A.; Thomassen, R.W. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Presacrifice tests and gross necropsy examinations have been completed on 140 beagles scheduled for sacrifice at 5 years and 54 of 140 dogs scheduled for sacrifice at 8 years of age. Sacrifice of 11-year-old dogs is scheduled to begin early this year (1979). As the protocol now exists, it is anticipated that most dogs would survive to complete the 11-year segment, but only a fraction of dogs would be available to sacrifice at 14 years of age.

14315 (FDA—79-8042, pp 24-30) **Gross and surgical pathologic findings in beagles receiving gamma radiation during development and sacrificed at 8 years of age.** Lovering, S.L.; Hargis, A.M.; Benjamin, S.A.; Thomassen, R.W. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Gross necropsy examinations have been completed on 54 of 140 beagles scheduled for sacrifice at 8 years of age. Currently the only major gross pathologic change that has been correlated with radiation treatment is nodular hyperplasia of the liver.

14316 (FDA—79-8042, pp 31-34) **Malignancy as a cause of death in nonsacrifice Segment III beagles receiving gamma radiation during development.** Benjamin, S.A.; Hargis, A.M.; Lovering, S.L.; Thomassen, R.W.; Angleton, G.M.; Lee, A.C.; Brewster, R.D.; Brooks, R.K. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

As of December 31, 1978, 31 Segment III beagles had died or been euthanized because of a malignant neoplasm. Twenty-five of the 31 had been irradiated. Fifteen of the 25 irradiated dogs were exposed at either 55 days postcoitus (dpc) or 2 days postpartum (dpp) to 20 or 100R. Of these 15, 4 dogs irradiated at either 55 dpc or 2 dpp died with malignancies prior to 2 years of age, an unusual occurrence in the dog. Eight irradiated and no control dogs developed malignant lymphoma. Four of the dogs with lymphoma were irradiated at 55 dpc. These findings suggest a relatively high sensitivity for radiation carcinogenesis in dogs exposed in the perinatal period.

14317 (FDA—79-8042, pp 35-39) **Malignant lymphomas occurring in beagles exposed to low-level radiation.** Lovering, S.L.; Benjamin, S.A.; Hargis, A.M.; Thomassen, R.W. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

With less than one-third of the Segment III beagles dead, malignant lymphoma has been the cause of death in eight dogs, all of

these having been irradiated. Four dogs were exposed at 55 days postcoitus (dpc), two to 20R, and two to 100R. Three dogs were exposed to 100R at 365 days postpartum (dpp). One dog was exposed at 8 dpc to 20R. No lymphomas have been seen in controls. The occurrence of malignant lymphoma in CRHL beagles exceeds that reported for the general canine population by a large margin.

14318 (FDA—79-8042, pp 40-44) **Testicular tumors in Segment III beagles irradiated during development.** Hargis, A.M.; Thomassen, R.W.; Benjamin, S.A. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Records on 236 male beagles were reviewed for presence of testicular tumors. Among 37 dogs with tumors, 29 had interstitial cell tumors, 8 had Sertoli cell tumors, and 2 had seminomas. Average age at diagnosis was 8.31, 6.99, and 8.22, respectively, for the three types of tumors. Fifteen dogs had multiple tumors in one testicle or one or more tumors in both testicles. Testicular tumors were detected at earlier ages in dogs exposed to gamma radiation.

14319 (FDA—79-8042, pp 45-50) **Thyroid neoplasia in beagles receiving whole-body irradiation during development.** Stephens, L.C.; Norrdin, R.W.; Hargis, A.M.; Benjamin, S.A. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Twenty malignant and 17 benign thyroid neoplasms have been diagnosed in 37 Segment III beagles. Nine males and 8 females had follicular adenomas, and 7 males and 13 females had thyroid carcinomas. The dogs ranged in age from 5.16 to 10.66 years. Twenty-nine of the 37 dogs (78.4 percent) were hypothyroid. Twenty-six (70.3 percent) dogs were irradiated. Of the 26 irradiated dogs 15 had malignant tumors. Fourteen (37.8 percent) of the 37 dogs had the same sire.

14320 (FDA—79-8042, pp 51-54) **Mammary neoplasia in beagles exposed to gamma radiation during development.** Benjamin, S.A.; Johnson, V.M.; Hargis, A.M.; Lovering, S.L.; Thomassen, R.W.; Brewster, R.D.; Brooks, R.K. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

A total of 261 Segment III female beagles had developed one or more mammary neoplasms as of December 31, 1978, and 192 (74 percent) of these had been irradiated. Sixty-nine of 180 controls (38.3 percent) had tumors. The incidence in the various irradiated groups ranged from a low of 16 of 120 (13.3 percent) in dogs exposed to 100R at 70 days postpartum (dpp) to a high of 48 of 120 (40 percent) in dogs exposed to 100R at 365 dpp. No significant differences were found among the different experimental groups with respect to the crude incidence of benign or malignant neoplasms or both combined. Since the colony is relatively young with respect to mammary neoplasia, this subject bears continued consideration.

14321 (FDA—79-8042, pp 55-59) **Eye lesions in Segment III beagles of the CRHL Long-Term Study: a progress report.** Lee, A.C.; Angleton, G.M.; LoPresti, C.A. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Annual clinical eye examinations have been performed on the CRHL Segment III beagles since inception of the study. It is now possible to present the estimated cumulative incidence probabilities for selected ocular lesions based on the complete set of data. Although there appears to be relatively little difference between most experimental groups, there is some evidence that ocular lesions may be more frequent in dogs irradiated at 28 or 55 days postcoitus (dpc) or 2 days postpartum (dpp).

14322 (FDA—79-8042, pp 61-66) **Investigation of thyroid disease in the CRHL beagle colony.** Stephens, L.C.; Norrdin, R.W.; Hargis, A.M.; Brewster, R.D.; Brooks, R.K. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Incidence, age, sex, and irradiation status of selected hypothyroid CRHL beagles are presented in this report. Morphology of thyroid gland lesions and thyroid tumor incidence are also presented for the hypothyroid beagles that were necropsied. Values for cholesterol, hematocrit and triiodothyronine as measured by radioimmunoassay (T3-RIA) are discussed and compared in beagles diagnosed as hypothyroid.

14323 (FDA—79-8042, pp 67-72) **Morphologic features of focal hyperplasia and neoplasia of the thyroid in CRHL beagles.** Stephens, L.C.; Hargis, A.M.; Norrdin, R.W. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

This report outlines criteria for the differentiation of focal hyperplasia, adenomas, and carcinomas of the beagle thyroid. A classification scheme for benign and malignant thyroid neoplasia is outlined.

14324 (FDA—79-8042, pp 78-84) **Nodular hyperplasia of the liver in the beagle dog.** Fabry, A.; Benjamin, S.A.; Angleton, G.M.; Thomassen, R.W. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Gross and light microscopic features of focal nodular hyperplasia of the liver were investigated in 67 of 444 beagle dogs, 55 from the F_1 generation and 389 from Segment III of the long-term study. Morphometric data were obtained on nodules from 10 dogs. The nodules were morphologically similar in both the irradiated and unirradiated dogs. In comparison with hepatocytes of the adjacent parenchyma, nodule hepatocytes were smaller on the average but varied more in size. A lower proportion of the hepatocytes in nodules were binucleate and a higher proportion were found in mitosis. The incidence of hyperplastic nodules was directly related to age but was not influenced by sex. The age-related incidence apparently was higher in irradiated dogs than in controls. Nodular hyperplasia occurred in association with primary hepatocellular neoplasms in only two dogs.

14325 (FDA—79-8042, pp 85-87) **Renal alterations associated with low-level perinatal gamma irradiation.** Jaenke, R.S.; Davis, D. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Seventy-day-old dogs exposed to 0, 20, 100 or 150 R at 55 days postcoitus (dpc) or 2 days postpartum (dpp) have been examined morphometrically for evidence of early renal damage related to perinatal irradiation. Preliminary results indicate a slight but variable effect in irradiated dogs characterized by reductions in nephron number, arrest in glomerular maturation and hypertrophy of mature glomeruli.

14326 (FDA—79-8042, pp 88-90) **Renal function changes associated with aging and ionizing radiation.** Miller, C.W.; Norrdin, R.W.; Nealeigh, R.C. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Renal function testing of irradiated and nonirradiated beagles at CRHL has been conducted for the past 8 years. The major findings in the past 14 months have been further deterioration of renal function in irradiated Segment II dogs which are now 8 years of age. The small group of dogs which had unilateral nephrectomy 4 years ago after the development of chronic renal disease have either died or shown dramatic declines in renal function. Sulfanilate clearance data in the Segment III dogs is nearly complete and will be analyzed for age and radiation-related changes in renal function.

14327 (FDA—79-8042, pp 91-95) **Extrarenal effects of perinatal irradiation: ^{47}Ca absorption and duodenal calcium binding activity in beagles with chronic renal failure.** Norrdin, R.W.; Miller, C.W.; Arnold, J.S.; Taylor, A.W. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

^{47}Ca absorption and duodenal calcium binding activity were studied in 4-5-year-old Segment II beagles with various degrees of chronic renal failure as a result of perinatal irradiation (270 to 435 R). ^{47}Ca absorption was no different in three uremic dogs when compared to three controls. Calcium binding activity was significantly lower in irradiated dogs than in controls, regardless of whether they were uremic or not. This may be attributable to radiation-induced destruction of outer cortical nephrons. There is evidence that this is the formation site in the kidney of the vitamin D metabolite responsible for duodenal calcium-binding protein synthesis.

14328 (FDA—79-8042, pp 96-97) **Renal function in beagles receiving high-level renal irradiation.** Miller, C.W.; Nealeigh, R.C.; Gavin, P.R.; Gillette, E.L. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Four beagle dogs with ultrasonic flow cuffs implanted around the renal arteries were given 1500 R exposures to the kidneys in two stages. Clearance tests using sulfanilate and hippuran ^{131}I and renal blood flow measurements were carried out during the 3-month period following irradiation. No changes in blood flow or clearance rates were seen during the study period.

14329 (FDA—79-8042, pp 98-100) **Cardiovascular studies in long-term Segment III beagles scheduled for sacrifice at 8 years of age.** Miller, C.W.; Nealeigh, R.C. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

A battery of cardiovascular diagnostic techniques have been routinely employed in beagles during the 6-month period prior to sacrifice. Cardiac function has been evaluated using echocardiography and large vessel function has been assessed using pulse Doppler velocity detection schemes and echo tracking devices. Arterial blood pressure measurements have also been made routine-

ly. From these determinations, age-related and radiation induced changes in vessel wall mechanics, regional blood flow, blood pressure, and cardiac dynamics can be evaluated. This report summarizes the basic approach to these measurements and presents data collected during the past 14 months. The dogs evaluated were approximately 8 years of age.

14330 (FDA—79-8042, pp 101-103) **Echocardiology in the beagle.** Miller, C.W.; Nealeigh, R.C. Aug 1979.

In CSU-FDA Collaborative Radiological Health Laboratory annual report, 1978.

Echocardiographic techniques for evaluating cardiac and large vessel function are being utilized in beagles prior to their sacrifice at 8 years of age. Twenty-seven dogs have been evaluated thus far with this noninvasive and relatively simple procedure. All dogs in the 8- and 11-year-old-sacrifice groups will be evaluated using echocardiology.

14331 (LBL—7448) **Biology and Medicine Division annual report, 1977.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1977. Contract W-7405-ENG-48. 97p. Dep. NTIS, PC A05/MF A01.

Individual projects are indexed. (PCS)

14332 (UCD—472-125, pp 72-82) **Radiation leukemogenesis studies.** Stitzel, K.A.; Wilson, F.D.; Shifrine, M.; White, R.G.; Macias, T.; Munn, S.L.; Kroll, M.R.; Aotaki, A. Oct 1979.

In Annual report, 1978-1979.

The results obtained for the ^{60}Co leukemogenesis study through May 31, 1978 are reviewed. During the year 66 animals were added to the study in the three highest dose levels and controls; 25 were sacrificed. Death from radiation-induced thrombocytopenia occurred in one animal exposed at 2.2 R/day to 1054 total R, the lowest dose rate in which an aplastic condition has been seen at this Laboratory. In addition, of the four adult animals placed in the field as a comparison with the ^{60}Co-irradiated animals at Argonne National Laboratory, three died of bone marrow aplasia at doses of 825 to 1002 R given at 11 R/day. This compares well with our weanling results and is much lower than results reported elsewhere. Future work will concentrate on age-related effects and characterization of the aplasia produced.

14333 (UCD—472-125, pp 83-84) **Effects of chronic whole-body gamma irradiation on cell mediated immunity.** Shifrine, M.; Taylor, N.J.; Wilson, F.D.; DeRock, E.W.; Wiger, N. Oct 1979.

In Annual report, 1978-1979.

The whole blood lymphocyte stimulation test has been used to estimate the effects of chronic, whole-body, gamma irradiation in the dog. At lower dose levels, 0.07 and 0.33 R/day to cumulative dose of about 50 and 250 R, there was no change in cell mediated immunity. Dogs at high dose levels were affected. Dogs which succumbed to aplastic anemia at high doses had reduced immunological responses. Dogs which survived these high doses showed a temporary depression. When aplastic anemia was initially noted, there was a differential response to PHA and Con-A stimulation. The response to the former mitogen was profoundly reduced, but Con-A stimulated cells were unaffected, indicative of the development of radioresistant cell lines. As the dogs progressed toward aplastic anemia, all T lympocytes were negatively affected.

14334 (UCD—472-125, pp 106-107) **Canine lymphocyte activating factor (LAF).** Shifrine, M.; Whaley, C.B.; Wilson, F.D.; Taylor, N.J. Oct 1979.

In Annual report, 1978-1979.

The immune response of an animal is the sum of the result of the interaction of various cells mainly through soluble mediators. It is not enough to look at specific cell populations, it is also necessary to study the interactions between purified cell population. The effect of one subpopulation on another is via soluble mediators. We have been studying one (of several) such mediators in its relation to radiation effects on the immune response. Lymphocyte activating factor (LAF) is defined functionally as a potentiator of the response of thymocytes to phytohemagglutinin (PHA) or concanavalin (con-A). It can also elicit response of unstimulated subpopulations separated from the thymus. It is a product of adherent populations, presumably macrophages. It has been shown to be produced by human, rabbit, and mouse cells, but has not been reported in the dog. It also was shown to be present in higher concentrations in irradiated mice than in comparable unirradiated mice. We have shown that LAF is produced by plastic-adherent populations derived from peripheral blood. Currently we are working to determine the lymphocyte subpopulations with which LAF interacts.

14335 (UCD—472-125, pp 108-109) **Autologous transplantation.** Stitzel, K. Oct 1979.

In Annual report, 1978-1979.

As part of the leukemogenesis study, bone marrow transplantation experiments are planned to investigate injury to the marrow stroma exposed to continuous low level gamma radiation and the role this injury plays in the induction of myeloproliferative disorders. The initial studies were designed to perfect the techniques of autologous bone marrow transplantation at Davis.

14336 (UCD—472-125, pp 110-111) **Effect of chronic radiation (^{60}Co) on neutrophilic migration: a possible index of damage.** Wiger, N.; Shifrine, M. Oct 1979.

In Annual report, 1978-1979.

The leukocyte migration inhibition test (LMI) has been used successfully to assess cell mediated immunity (CMI) in humans and small laboratory animals. In the canine, however, there is a poor correlation between the LMI and in vivo CMI as assessed by skin tests and lymphocyte stimulation assays. We have modified the granulocyte isolation technique, and we currently are assessing different methods for the evaluation of leukocyte function.

14337 (UCD—472-125, pp 112-113) **Radiation effects on lymphohematopoietic colonies: existence of subpopulations of lymphocyte progenitors with differing radiosensitivities and evolution of radioresistant subpopulations in response to continuous irradiation in beagles.** Wilson, F.D.; Shifrine, M.; Dyck, J.A.; Whaley, C.B. Oct 1979.

In Annual report, 1978-1979.

In vitro dose-response relationships were studied for x-irradiation in beagles using a methylcellulose culture system which allows for the growth of T-lymphocyte colonies in response to mitogenic stimulation of peripheral blood lymphocyte by PHA and con-A. The best fit for the resultant survival curves was biexponential indicating the existence of subpopulations of T-lymphocyte progenitors with varying degrees of radiosensitivity. Studies performed on blood obtained from beagles receiving continuous irradiation demonstrated an increased survival for the con-A response but not for PHA. These results demonstrate the evolution of radioresistant con-A responsive T-lymphocyte progenitor in response to continuous irradiation and imply that the target cells for PHA and con-A represent distinct subpopulations of T-lymphocytes.

14338 (UCD—472-125, pp 114-116) **In vitro x-irradiation survival study on murine B lymphocyte colony formation following continuous, in vivo gamma irradiation.** Dyck, J.; Wilson, F.D.; Knospe, W.H.; Graham, R.; Hines, D. Oct 1979.

In Annual report, 1978-1979.

The response of B-lymphocyte colony formation to in vitro x-irradiation is reported for chronically γ-irradiated and normal control mice. Overall colony counts were found to be depressed in the in vivo irradiated mice; however, the D37 for in vitro x-irradiation (relative to own controls) for both groups of mice was found to be nearly identical. The murine B-lymphocyte colony technique (CFU-L "B") is described.

14339 (UCD—472-125, pp 117-119) **Formation of lymphocyte colonies in semisolid mixed-lymphoctye cultures.** Wilson, F.D.; Whaley, C.B.; Shifrine, M. Oct 1979.

In Annual report, 1978-1979.

Peripheral blood lymphocytes obtained from humans, dogs and mice formed lymphocyte colonies in agar and methylcellulose cultures in response to allogeneic and xenogeneic (mixed lymphocyte) stimulation. The majority of such colonies were demonstrated to be of T-cell type based on their ability to rosette with sheep red blood cells. In addition to lymphocytes, surface adherent populations of macrophages including multinucleated giant cells were observed in the mixed lymphocyte cultures.

14340 (UCD—472-125, pp 120-122) **Technique for in situ morphologic analysis of colony-forming units (CFU) grown in semisolid media.** Klein, A.K.; Wilson, F.D.; Golde, D.; Hinds, D.; Conard, M.; Gielow, F.I. Oct 1979.

In Annual report, 1978-1979.

A technique for in situ morphologic analysis of mammalian cells derived from blood-forming organs and cultured in semisolid media has been developed. The technique is used to study colony-forming units of the granulocyte-macrophage series (CFU-C) and of the lymphocytic series (CFU-L). In addition, the technique is used to anlyze colonies grown in semisolid media in mixed lymphocyte cultures.

14341 (UCD—472-125, pp 123-126) **Formation of spontaneous hematopoietic colonies in semisolid cultures of lymphocyte enriched fractions of peripheral blood from beagles.** Wilson, F.D.; Whaley, C.B.; Shifrine, M. Oct 1979.

In Annual report, 1978-1979.

The formation of hematopoietic colonies in semisolid cultures derived from lymphocyte enriched fractions of canine peripheral blood is described. Such colonies occurred in the absence of either mitogens or colony stimulating factor. Although the mechanism(s) involved in such colony formation is not known, preliminary results suggest an increased tendency for spontaneous colony formation with age and a possible relationship to low-level irradiation and neoplasia. The observation underlines the importance of doing non-

mitogen stimulated control cultures in order to determine the true influence of mitogens or growth factors on colony formation.

14342 (UCD—472-125, pp 127-128) **Purification and properties of superoxide dismutase from Periplaneta americana.** Misra, H.P.; Froman, B. Oct 1979.

In Annual report, 1978-1979.

Soluble extracts of Periplaneta americana have been shown to contain a single, electrophoretically distinct, superoxide dismutase. This enzyme seems to be highly sensitive to cyanide as well as to chloroform-ethanol mixture. The enzyme has been purified to homogeneity and awaits further characterization.

14343 (UCD—472-125, pp 130-141) **Cumulative causes of death in radionuclide-treated beagles.** Chrisp, C.E.; Spangler, W.L.; Pool, R.R.; Book, S.A. Oct 1979.

In Annual report, 1978-1979.

Tables 1 and 2 show causes of death of all ^{90}Sr- and ^{226}Ra-treated dogs, respectively, as of June 30, 1978. The tables do not include biopsy data, contributory causes of death, or other significant lesions found at necropsy. The experimental design of the $^{90}Sr/^{226}Ra$ study and treatment codes (R - for ^{226}Ra-injected dogs, and D- and S- for ^{90}Sr-fed and -injected dogs, respectively) are presented elsewhere. (PCS)

14344 **Lung tumorigenesis in the Syrian hamster from particulate sources of ^{147}Pm β radiation.** Anderson, E.C.; Holland, L.M.; Prine, J.R.; Smith, D.M. (Los Alamos Scientific Lab., NM). *Radiat. Res.;* **79**: No. 2, 349-367(Aug 1979).

Syrian hamsters were exposed to ^{147}Pm β radiation from ceramic microspheres permanently lodged in the capillary bed of the lung. Lung burdens ranged from 6000 to 152,000 spheres, with activities of either 70 or 450 pCi/sphere. Lung burdens of 0.4 to 16 μCi gave initial dose rates of 0.65 to 20.5 krad/year. No life shortening resulted. Tumor incidence increased with the logarithm of dose rate, reaching 30% at about 15 krad/year. Tumor induction time was about 300 days, and the incidence rate reached a maximum at about 600 days postexposure. For all experiments, the distribution of tumor types was 35% adenomas, 41% adenocarcinomas, and 24% epidermoid carcinomas. No other lesion correlated with tumor incidence; in particular, the bronchiolar adenomatoid lesions was not a reliable estimator of tumorigenicity.

14345 **Collagen localization in lung parenchyma irradiated by inhaled $^{238}PuO_2$ particles.** Diel, J.H.; Short, R.K. (Inhalation Toxicology Research Inst., Albuquerque, NM). Contract EY-76-C-04-1014. *Radiat. Res.;* **79**: No. 2, 417-423(Aug 1979).

Syrian hamsters were exposed via inhalation to an aerosol of $^{238}PuO_2$. Animals were sacrificed at 136 days after exposure and their lungs were fixed in situ, embedded, and sectioned. Collagen distribution and plutonium-particle locations were obtained from autoradiographs stained for collagen using Van Gieson's stain. Stainable collagen accumulated preferentially in the regions immediately surrounding individual plutonium particles and in regions of high-particle concentration.

14346 **Some problems arising in analysis of large-scale animal irradiation experiments.** Fry, R.J.M.; Staffeldt, E.; Tyler, S.A. (Argonne National Lab., IL). *Environ. Int.;* **1**: No. 6, 361-366(1978).

From Conference on environmental biological hazards and competing risk; Oak Ridge, TN, USA (7 Sep 1977).

This paper describes some of the problems that occur in experiments designed particularly to study the effects of irradiation. One of the purposes of such experiments is to provide data that allow an informed judgment on estimates of the risks for man after exposue to radiation. It is no trivial matter to establish whether exposure to agents, such as radiation, increases the probability of a tumor arising de novo or whether the effect is an advancement of the time of appearance of naturally occurring tumors. In many murine tumors, the problem of establishing which of these two possibilities is the case is increased by the high natural incidence. In order to interpret the data from carcinogenesis experiments, a knowledge of the natural history of the tumor of interest is necessary. In this paper we present data that help to elucidate the biology of lung tumors in hybrid $B6CF_1/An1$ mice. The rising incidence of many tumors late in life raises the question of whether a common systemic factor is involved. In experiments with female mice, relatively low doses of radiation may sterilize the ovary with subsequent hormonal imbalances that in turn may influence the appearance of tumors in a number of hormone-influenced tissues. We have found that radiation may increase not only the age-specific rates of tumors but also the probability of the number of different tumor types. The possibility of a lack of independence of the occurrences of different tumors complicates the data analysis. To answer some of the questions we have raised, it would be of considerable help to have data on the prevalence of tumors; however, such data usually involve serial killing which is costly. We have examined the possibility of obtaining prevalence data for lung tumors by the determination of the incidence of lung tumors in mice dying from causes other than lung tumors. There appears to be no difference in the prevalence of lung tumors determined by using either this approach or serial killing.

14347 **Determination of causes of death in animal survival experiments.** Holland, J.M. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Environ. Int.;* **1**: No. 6, 367-370(1978).

From Conference on environmental biological hazards and competing risk; Oak Ridge, TN, USA (7 Sep 1977).

Life-span studies, using the laboratory mouse, are an efficient means for determining potential chronic toxicity of various materials. However, difficulties that affect the analysis of the data include (a) incomplete and missing observations due to canabilism or autolysis, (b) possible differences in overall mortality rate between treated and control populations that preclude assessments based upon observed final incidence, and (c) potential interaction between specific pathological states. Being aware of these difficulties does not eliminate their consequence, but careful attention to ascertaining the presence or absence of a disease state coupled with an assessment of its significance for each individual can allow greater confidence to be placed in data obtained from survival studies. The question of possible interaction between disease states is better approached experimentally by judicious use of serial killing to define age-specific disease prevalence. Many diseases are difficult to identify in animals as small as the mouse. At the other extreme, too much importance may be attributed to some disease states, not because of their lethality, but because of their ease of detection. One way to minimize the uncertainties introduced by conscious and unconscious observational bias is to adhere to a highly systematic tissue examination of every animal, regardless of condition or apparent cause of death. Through application of well-defined and stable diagnostic criteria a better appreciation can be obtained of the full spectrum of lethal and incidental pathologies observed in animals dying throughout the survival study.

14348 **Stochastic mortality theory and the mortality potential: a biophysical model for certain competing risks.** Sacher, G.A. (Argonne National Lab., IL). *Environ. Int.;* **1**: No. 6, 381-389(1978).

From Conference on environmental biological hazards and competing risk; Oak Ridge, TN, USA (7 Sep 1977).

The theory of competing risks cannot be based entirely on the analysis of postmortem pathology data. It is necessary also to know the prevalence and residence times of the diseases in question, separately and jointly, in the living population at risk. It is also necessary to have a conceptual model of the transition process from health to disease, or from one disease state to another, within the organism, so that the formal transition probabilities estimated from epidemiological data can be interpreted in biophysical terms as arising from changes in the physico-chemical state of the organism. This paper offers such a model for transition processes arising from fluctuations of physiological state (for example, lapse into diabetic coma or insulin shock as a result of extreme high or low excursions of the blood sugar level). A Gaussian fluctuation process is postulated, and the transition probability, or incidence rate, is calculated as the frequency with which the state variable fluctuates beyond a specified distance, Λ, from the mean state. An explicit solution is given for the limiting, but biologically reasonable, case that such an excursion is a rare event. In this case, the transition probability varies exponentially for linear displacement of Λ or of the dispersion of fluctuations, σ. If Λ decreases, and/or σ increases, as a linear function of age, this model yields an exponential (Gompertzian) relation of disease incidence to age. Generalization to more than one variable is accomplished by introducing the concept of a mortality potential surface, in which the disease transitions are geometrized as saddle points, or passes, on the surface.

INVERTEBRATES

REFER ALSO TO CITATION(S) 14227, 14342

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

ANIMALS

14349 (PNL—2850(Pt.4), pp 2.37-2.38) **Microdosimetry of internal sources.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

The purpose of this study is to develop practical methods for calculating microdosimetric distributions of plutonium or other alpha-emitting elements that are deposited especially as particulates in soft tissue and lung tissue. This study will aid the correlation and extrapolation of radiation effects measured at different levels of exposure and in different species. Computational methods will be developed and tested in the Radiological Physics Section. Concur-

rently, the Radiological Health Section will develop cell and tissue models in which those methods will be applied.

14350 (PNL—2850(Pt.4), pp 2.39-2.40) **Dosimetry of internal emitters.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

This program provides radiological and dosimetric guidance and support to radiobiological studies at PNL. The program considers radiological design of experiments and materials and includes theoretical and experimental dosimetry to various tissues and organs. These data are then related to observed biological effects. In particular, absorbed dose was calculated and measured in experiments that are attempting to develop dose-effect relationships for ^{238}Pu particle exposures in beagle dogs and ^{85}Kr gaseous exposures to rats.

NUCLIDE KINETICS AND TOXICOLOGY

REFER ALSO TO CITATION(S) 14274

MAN

REFER ALSO TO CITATION(S) 13997, 13998, 14244, 14275, 14282

14351 (BNL—27175) **Splenic sequestration of Tc-99m labeled heat treated red blood cells.** Atkins, H.L.; Goldman, A.G.; Fairchild, R.G.; Oster, Z.H.; Som, P.; Richards, P.; Meinken, G.E.; Srivastava, S.C. (Brookhaven National Lab., Upton, NY (USA); State Univ. of New York, Stony Brook (USA). Health Science Center). 1979. Contract EY-76-C-02-0016. 26p. (CONF-791165—1). Dep. NTIS, PC A03/MF A01.

From 65. annual meeting of the Radiological Society of North America; Atlanta, GA, USA (25 Nov 1979).

The rate of blood clearance and spleen uptake as well as the total spleen uptake of heat damaged red blood cells labeled with Tc-99m was determined in eight patients, six of whom had chronic lymphatic leukemia, one had polycythemia vera and one had eosinophilia of unknown origin. Spleen uptake at 2 hrs was 72.0 +- 18.5%. Approximately 82.6% of the initial radioactivity was cleared from the blood by 2 hrs with a rapid T 1/2 component of 6.3 +- 4.7 min. The T 1/2 of splenic uptake was 8.3 +- 4.6 min with a plateauing of splenic radioactivity by 30 min. The preliminary results indicate that the method of preparation is reliable but the usefulness of the method for evaluating spleen function remains to be determined.

14352 (NUREG—0060-SUP-1) **Generic environmental statement of routine use of plutonium-powered cardiac pacemakers. Final report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Standards Development). May 1979. 18p. NTIS, PC A02/MF A01.

The Final Environmental Statement on Routine Use of Plutonium-Powered Cardiac Pacemakers (FES) was issued in July 1976. Supplement 1, prepared in 1978, updates the FES with respect to power sources for pacemakers. Particular attention is given to the non-nuclear lithium batteries as alternatives to Pu-238 power sources in pacemakers. Supplement 1 also considers the current extent of pacemaker use and makeup of the patient population and concludes that the FES' conclusion is still valid, that distribution of Pu-238 powered pacemakers for routine use should be authorized subject to specific conditions.

ANIMALS

REFER ALSO TO CITATION(S) 14227, 14228, 14277, 14283, 14309, 14343

14353 (COO—119-254) **Research in radiobiology. Annual report of work in progress in the internal irradiation program.** (Utah Univ., Salt Lake City (USA). Radiobiology Div.). 31 Mar 1979. Contract EY-76-C-02-0119. 307p. Dep. NTIS, PC A14/MF A01.

The toxicity, retention, biological effects, distribution, decorporation and measuring techniques of radionuclides are discussed. Calculations of trabecular bone formation rates from tetracycline labeling is included. The characteristics of trabecular bone in the Rhesus monkey are discussed. Studies on the early retention and distribution of radium 224 in beagles are included. Studies on the decorporation of plutonium and americium in dogs by DTPA and salicylic acid are presented.

14354 (COO—119-254, pp 9-14) **Bone sarcomas at low doses of α-radiation in beagles.** Mays, C.W.; Taylor, G.N.; Stevens, W.; Jee, W.S.S.; Wrenn, M.E. 31 Mar 1979.

In Research in radiobiology. Annual report of work in progress in the internal irradiation program.

At low doses of α-particle radiation, the possibility of a linear dose response cannot be rejected by our present data on bone sarcoma induction by ^{239}Pu and ^{226}Ra in beagles.

14355 (COO—119-254, pp 74-80) **^{233}U in the skeleton of the beagle.** Stevens, W.; Bruenger, F.W.; Atherton, D.R.; Howerton, G.; Taylor, G.N.; Smith, J.M.; Buster, D.S. 31 Mar 1979.

In Research in radiobiology. Annual report of work in progress in the internal irradiation program.

The distribution of ^{233}U in the skeleton has been determined as a function of time after its intravenous injection. Retention functions were calculated for individual parts of the skeleton. The biological halflife of U in individual members of the skeleton varied by a factor of as much as ~ 185. Skeletal parts whose ratio of ashed weight/wet weight was low, exhibited short biological halflives whereas those with a high ashed weight/wet weight ratio had long biological halflives for the nuclide. The loss from individual parts was related to their trabecular bone content. Initially, uranium was deposited nonuniformly on bone surfaces. Throughout the period of observation the surface deposition changed partly to a volume distribution but the strongly heterogeneous character of the initial surface deposit was maintained as heavy surface deposits became fewer in number but little change in intensity was observed.

14356 (COO—119-254, pp 135-139) **Salicylic acid failed to increase the efficacy of Ca-DTPA in the decorporation of plutonium and americium.** Jones, C.W.; Lloyd, R.D.; Mays, C.W. 31 Mar 1979.

In Research in radiobiology. Annual report of work in progress in the internal irradiation program.

Male and female C57BL/Do mice were each given a single i.p. injection of $^{237+239}$Pu + ^{241}Am as the citrate complex at 45 days of age. Twice weekly i.p. injecctions of either 500 μmol/kg Ca-DTPA or 500 μmol/kg Ca-DTPA, mixed just before injection with 2000 μmol/kg salicylic acid (SA), were begun 3 days after nuclide administration and continued for 5 weeks. Control mice were injected each time with isotonic saline. Nuclide retention was determined by in vivo counting using NaI(T1) spectrometry. At the end of treatment, total-body retention of Pu or Am in the mice given Ca-DTPA was significantly lower ($P < 0.001$) than in the control animals. Mice treated with Ca-DTPA + SA were statistically indistinguishable from mice treated with Ca-DTPA ($P > 0.07$ for ^{237}Pu and $P > 0.20$ for ^{241}Am).

14357 (COO—119-254, pp 140-144) **Effectiveness of mixed ligand chelation for the removal of plutonium and americium in the hamster.** Bruenger, F.W.; Stevens, W.; Atherton, D.R.; Greenlee, R.R.; Mays, C.W.; Jones, C.W.; Lloyd, R.D. 31 Mar 1979.

In Research in radiobiology. Annual report of work in progress in the internal irradiation program.

DTPA and the combination of DTPA plus salicylic acid or other benzene derivatives which are ortho-di-substituted with functional groups containing one or more oxygen and/or nitrogen atoms as electron donors, were tested for their ability to remove ^{239}Pu and/or ^{241}Am from hamsters. Mixed ligand chelation of these actinides by combination of DTPA and any one of these compounds did not result in an increased efficacy for the removal of actinides, as has been reported elsewhere.

14358 (COO—119-254, pp 145-150) **Examination of some chelating agents to decorporate fixed body-burdens of cadmium.** Jones, C.W.; Lloyd, R.D.; Mays, C.W. 31 Mar 1979.

In Research in radiobiology. Annual report of work in progress in the internal irradiation program.

Male and female C57BL/Do mice, five to six months old, were injected intraperitoneally with 2.0 mg/kg cadmium citrate labeled with about 2.0 μCi ^{109}Cd per mouse. Three days after cadmium injection, male mice were injected subcutaneously with 2,3 dimercaptopropanesulfonate (DMPS), and female mice were injected subcutaneously with calcium disodium ethylenediaminetetra-acetate (CaEDTA), salicylic acid (SA), or 2,3 dimercaptopropanesulfonate, alone, or in combination. A total of four treatment injections were administered to each group of mice. Cadmium total-body retention was measured by in vivo counting using NaI(T1) spectrometry. Male mice given DMPS, and groups of females given EDTA, SA, EDTA + DMPS, EDTA + SA, or EDTA + DMPS + SA had total-body retentions of cadmium no different from saline controls ($P > 0.05$). Measurement of cadmium content in kidneys, livers, gonads, and femora excised from test animals also showed no difference from corresponding organs in control animals ($P > 0.10$).

14359 (COO—119-254, pp 151-160) **Decorporation of Pu or Am in beagles by 3,4,3-licams.** Lloyd, R.D.; Bruenger, F.W.; Atherton, D.R.; Jones, C.W.; Weitl, F.L.; Durbin, P.W.; Raymond, K.N.; Taylor, G.N.; Stevens, W.; Mays, C.W. 31 Mar 1979.

In Research in radiobiology. Annual report of work in progress in the internal irradiation program.

The compound, 3,4,3-LICAMS = N^1, N^5, N^{10}, N^{14}-tetra (2,3-dihydroxy-5-sulfobenzoyl)-tetraazatetradecane, tetrasodium salt, has

been tested as a decorporation agent in beagles given $^{237+239}$Pu + ^{241}Am citrate 30 minutes prior to its administration. Compared to untreated beagles or those given Ca-DTPA alone, the concentration of Pu in blood plasma was reduced significantly in dogs given LICAMS. The Am concentration in plasma was not reduced by LICAMS. Instead, the rate of Am disappearance from plasma was slowed substantially. Total-body retention of Am was reduced from control values only slightly by LICAMS, but markedly by DTPA. In contrast, Pu retention was diminished by LICAMS to a greater extent than by DTPA. The effects of combined LICAMS and DTPA treatment were not additive. It appears that 3,4,3-LICAMS is an effective chelating agent for Pu, but an indication of neophrotoxic effects in 2 dogs given 30 μmol LICAMS/kg indicates that the toxicity of the catecholates must be investigated thoroughly.

14360 (COO—4115-46, pp 75-82) **Development and therapeutic application of internally emitting radiopharmaceuticals.** Adelstein, S.J.; Bloomer, W.D. Apr 1979.

In Harvard-MIT research program in short-lived radiopharmaceuticals. Progress report, September 1, 1978-April 15, 1979.

The objective of this research is to develop and test internally administered radiopharmaceuticals using Auger-emitting (e.g. ^{125}I) and alpha-emitting (e.g. ^{211}At) radionuclides. The year's studies involved (a) establishment of the basic radiobiology of ^{211}At in vitro; (b) the use of 40-iodo (^{125}I) antipyrene as a probe to further explore the mechanisms of ^{125}I toxicity; (c) the radioiodination of various biologically active, DNA binding agents (d) astatination of various classes of biologically active molecules; (e) the determination of the critical parameters for the optimal treatment of a murine ovarian ascites tumor with 5-^{125}I-iododeoxyuridine; (f) the investigation of the effect of developing ascites on mediastinal lymphoscintigrams.

14361 (UCD—472-125, pp 142-148) **Comparison of effects in beagles from injected ^{226}Ra and ingested ^{90}Sr.** Raabe, O.G.; Parks, N.J.; Chrisp, C.E.; Book, S.A.; Goldman, M. Oct 1979.

In Annual report, 1978-1979.

Beagles injected with ^{226}Ra or fed ^{90}Sr have been under lifetime study during the past 17 years. This report summarizes the dose-response observations to June 30, 1978 based upon average dose rate (rad/day) to the skeleton from initiation of exposure to death. Comparison of the dose-response functions describing bone tumors showed an apparent reduction in relative biological effectiveness (RBE) from 1.5 to 0.05 for ^{90}Sr-Y average dose rates from 16 rads/day to 1.6 rads/day compared to radiation exposure from ^{226}Ra (and associated radon and progeny) in bone. Continued study of the 335 living dogs remaining in this bone-seeking radionuclide project will provide valuable information concerning the effects from ^{90}Sr and ^{226}Ra for dose rates below 1.6 rads/day. Results to date indicate that although bone cancer continues to be the important endpoint for ^{226}Ra, other cancer types may be more important for ^{90}Sr (such as soft tissue cancers adjacent to bone), particularly at lower dose rates.

14362 (UCD—472-125, pp 149-153) **Effects of continuous irradiation by ^{226}Ra and ^{90}Sr on hematopoiesis.** Wilson, F.D.; Munn, S.; Stitzel, K. Oct 1979.

In Annual report, 1978-1979.

The effects of continuous radiation on hematopoiesis by the internal emitters ^{226}Ra and ^{90}Sr were examined. The effect on granulopoiesis appeared most profound. Extensive effects on blood platelets were observed with ^{90}Sr, but not with ^{226}Ra. Neither radionuclide at the dose levels utilized resulted in compromised erythropoiesis. The changes occurred in the absence of any significant radiation dose to extramedullary sites. The results are discussed with respect to known mechanisms of hematopoiesis.

14363 (UCD—472-125, pp 154-164) **Lifespan dynamics of intraskeletal radionuclide distribution in radium-injected beagles.** Parks, N.J. Oct 1979.

In Annual report, 1978-1979.

The distribution of ^{226}Ra activity among the bone groups of the skeleton has been measured as a function of time after exposure for 12 beagles. The dogs were given 8 semimonthly injections of radium totalling 0.37 μCi/kg, 1.11 μCi/kg, or 3.33 μCi/kg between the ages of 435 and 535 days. Most of the bone groups were found to lose activity at approximately the same rate as the whole skeleton. By consideration of a partitioned clearance model, the whole-body retention function characteristic of beagles exposed to radium levels < 3.33 μCi/kg is partitioned into two functions representative of cancellous and compact bone. The relative radioactivity concentrations predicted by the model are in agreement with available data. Comparison of site-specific tumor-incidence for these beagles revealed an apparent 70-fold variation of dose-response among the bone groups studied.

14364 (UCD—472-125, pp 170-173) **Iodine-129: chronic exposure in rats.** Book, S.A.; McNeill, D.A. Oct 1979.

In Annual report, 1978-1979.

In response to the need for information on the risks associated with the handling and storage or disposal of radioactive wastes, we are investigating the biologic significance of iodine-129, a potentially hazardous, very long-lived radionuclide. We are evaluating the effects of long-term, low level radiation exposure relative to thyroid tumorigenesis and life shortening. Sixty rats have been introduced into a study in which they will receive lifetime exposures to high levels of ^{129}I. An additional 60 control animals are receiving ^{127}I in quantities equivalent to the ^{129}I diet in terms of elemental iodine. Although the experimental rats are maintaining a relatively high thyroidal ^{129}I burden, no ill effects have been observed.

14365 (UCD—472-125, pp 174-183) **Comparative effectiveness of ^{132}I and ^{131}I in the rat thyroid gland.** Book, S.A.; McNeill, D.A.; Parks, N.J.; Spangler, W.L. Oct 1979.

In Annual report, 1978-1979.

The thyroidal effects of short-lived radioiodines such as ^{132}I, ^{133}I, and ^{135}I have not been well defined. Instead, their effects have been assumed to be similar to those obtained by external x-ray exposure, or about 10 times as effective as the longer-lived and better understood radioiodine, ^{131}I. We report here the results of a study done to compare the effects of ^{132}I and ^{131}I and to confirm the suitability of the assumed 10-fold difference. We found the same effect in goitrogen-stimulated rat thyroid glands (in terms of 50% suppression of thyroid gland weight increase) at injected dosages of 94 μCi ^{132}I and 13 μCi ^{131}I. Doses, however, were 1.7 rads/μCi ^{132}I and 175 rads/μCi ^{131}I. The same 50% suppression for thyroid dose was found to occur at about 160 rads from ^{132}I and 2200 rads from ^{131}I, suggesting an approximately 14-fold increase in radiologic effectiveness of ^{132}I over ^{131}I.

14366 (UCD—472-125, pp 184-192) **Effects of ^{131}I on thyroid glands of guinea pigs of different ages.** Book, S.A.; McNeill, D.A.; Spangler, W.L. Oct 1979.

In Annual report, 1978-1979.

In view of the limited data on age-related radiosensitivity of the thyroid gland to radioiodine exposure, and because of a need for this information, we injected fetal, neonatal, weanling, and adult guinea pigs with single, graded dosages of iodine-131. Dosages were 0 to 100 μCi ^{131}I and resulted in thyroid doses ranging from hundreds to tens of thousands of rads. Subsequent testing of the animals' thyroid glands, in terms of function and size, yielded this order of radiosensitivity: weanling > fetus > neonate > adult. The differences, with regard to effects per rad, did not appear to exceed a factor of 6 between the most and least radiosensitive age-groups.

14367 (UCD—472-125, pp 193-199) **Predictive model of pulmonary toxicity from inhaled plutonium oxide aerosols.** Raabe, O.G.; Goldman, M. Oct 1979.

In Annual report, 1978-1979.

The potential toxicity of plutonium in people must be estimated using animal expermental data. Inhalation studies conducted at Battelle-Northwest Laboratory have been reviewed, and beagle mortality data to 1000 days after esposure to aerosols containing ^{238}Pu and ^{239}Pu were compared to the parallel data from Lovelace Foundation involving aerosols with ^{90}Sr-Y and ^{144}Ce-Pr. A simple model was developed showing a nearly identical dose-response relationship displaced by a characyeristic RBE for each aerosol type. The results include a predictive model of both time to death and dose-response probability at given exposure levels and times post-exposure. In addition, this model provides new insights into appropriate radiobiological principles describing acute pulmonary injury.

14368 (UCD—472-125, pp 200-231) **Comparative toxicity of strontium-90 and radium-226 experimental design and current status.** Book, S.A.; Chrisp, C.E.; Goldman, M. Oct 1979.

In Annual report, 1978-1979.

This study of the biologic effects of ^{90}Sr and ^{226}Ra on the beagle dog has, as its primary goal, the determination of possible long-term hazards to man from chronic exposure to low levels of irradiation. Animals received graded dosages of either radionuclide by several means of administration: continual ingestion of ^{90}Sr, a single intravenous injection of ^{90}Sr, or a series of eight intravenous injections of ^{226}Ra. The administration of ^{90}Sr and ^{226}Ra ended at 540 days of age; the animals are receiving chronic, low level radiation doses from these important bone-seeking radionuclides, and the significance of these low doses given at low dose rates is being investigated with regard to cancer production, physiological well-being, and shortening of life.

PLANTS

REFER ALSO TO CITATION(S) 14227

THERMAL EFFECTS

REFER ALSO TO CITATION(S) 14239

PLANTS

REFER ALSO TO CITATION(S) 13519

INVERTEBRATES

14369 (PB—295415) **Effects of thermal discharge on aquatic insects in the Tennessee Valley.** Tennessen, K.J.; Miller, J.L. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Environmental Planning). Jul 1978. 63p. NTIS PC A04/MF A01.

The Tennessee Valley Authority (TVA) conducted studies to (1) determine the thermal tolerances of selected aquatic insects and (2) investigate growth and emergence of those insects in the vicinity of TVA electric generating plants. Results of the study will be used to help establish thermal effluent limits to protect the aquatic ecosystem. Tolerance of the immature stages of Hexagenia bilineata and Coelotanypus sp. to thermal shocks of up to 20C was found to be great. However, eggs subjected to a shock of 15C resulted in a greatly reduced mean percentage of hatching. No difference in fecundity of adult females was found between ambient and thermal plume stations. Adult males from the heated discharge channel were significantly larger on the average than adult males from the ambient station.

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 14159, 14239

CELLS

REFER ALSO TO CITATION(S) 14300, 14302

14370 (LA—8063-MS) **Effects of arsenic, a toxic oil shale constituent, on cell proliferation and histone phosphorylation.** Gurley, L.R.; Walters, R.A.; Jett, J.H.; Tobey, R.A. (Los Alamos Scientific Lab., NM (USA)). Dec 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

Because of the casual association between arsenic and cancer in man, studies were initiated to determine if subtoxic levels of arsenic have effects on cell proliferation and chromatin constituents. Cultured CHO cells were treated with both As(III) and As(V), as sodium arsenite ($NaAsO_2$) and sodium arsenate (Na_2HAsO_4), respectively, to assess their biological impact. Quantitatively, arsenite was ten times more toxic than arsenate, with 5×10^{-5} M arsenite causing irreversible inhibition of culture growth. At subtoxic concentrations, 10^{-5} M $NaAsO_2$ induced culture growth kinetics that caused a cell division delay period followed by a spontaneous recovery of cell division. During this division delay, histone Hl phosphorylation was reduced to 40% of control. It then recovered to control levels just before recovery of cell division. Histone H2A phosphorylation was stimulated in the middle of the division delay period, followed by a stimulation of H3 phosphorylation just before recovery of cell division. The DNA synthesis rate was also reduced during division delay, but it did not recover before resumption of cell division. The ATP pool levels were unaffected at these low arsenite concentrations. Flow microfluorometric analysis demonstrated that cell-cycle progression was inhibited throughout the entire cycle during the division delay period. Upon recovery of cell division, cells in S and G_2 regained the capacity to resume cycle traverse earlier than did cells in G_1. These results support the conclusions that interphase Hl phosphorylation is not tightly coupled to DNA synthesis, but is vitally involved in cell-cycle progression. The results indicate that sodium arsenite modulates those histone phosphorylations involved with cell proliferation.

14371 (UCD—472-125, pp 40-43) **Biochemical studies of pulmonary alveolar macrophages.** Misra, H.P.; Fisher, G.L.; Fong, J.; Valentine, R. Oct 1979.

In Annual report, 1978-1979.

Pulmonary alveolar macrophages were collected and purified for measurement of biochemical functions including mixed function oxidase, superoxide production, lipid peroxidation and release of a proteolytic enzyme, elastase. Sensitive techniques are being developed to determine these biochemical characteristics of alveolar macrophage after exposure to particulate effluents from coal combustion.

14372 (UCD—472-125, pp 51-52) **Studies on in vitro dose-response characteristics of trace elements (Zn, Se) on lymphohematopoietic progenitors using semisolid culture systems.** Wilson, F.D.; Concoby, B.A.; Fisher, G.L. Oct 1979.

In Annual report, 1978-1979.

Using techniques allowing for the cloning of lymphohematopoietic stem and progenitor cells that have previously been used for radiation effects studies, the authors demonstrated the feasibility of their use as a sensitive short-term bioassay to determine the effects of fossil fuel combustion products on cellular pathways involved in hematopoiesis and immunological processes. (PCS)

14373 (UCD—472-125, pp 53-55) **Morphometric studies of pulmonary alveolar macrophages.** Finch, G.L.; Hayes, T.L.; Fisher, G.L. Oct 1979.

In Annual report, 1978-1979.

To evaluate further the potential health hazards of coal combustion products, detailed morphological and morphometric studies of pulmonary alveolar macrophages (PAM) have been initiated. These scanning electron microscopy (SEM) studies are complementary to our efforts to characterize the PAM as sensitive indicators of pulmonary exposure to coal fly ash. This report describes our recent efforts to provide a reproducible fixation technique to allow quantitation of morphological properties of PAM.

14374 (UCD—472-125, pp 56-58) **Effects of sera on the in vitro function of pulmonary alveolar macrophage.** Fisher, G.L.; McNeill, K.L. Oct 1979.

In Annual report, 1978-1979.

Quantification of pulmonary alveolar macrophage function in vitro requires detailed description of factors affecting the reproducibility and sensitivity of assay systems. This report demonstrates the importance of serum and possibly, associated zinc, as a mediator of in vitro macrophage function.

14375 (UCD—472-125, pp 86) **Suspension culture of macrophages: an in vitro source of purified mononuclear phagocytes and progenitors.** Buhles, W.C.; Shifrine, M. Oct 1979.

In Annual report, 1978-1979.

Mouse bone marrow cells were cultured in suspension in polypropylene tubes containing tissue culture media supplemented with a source of hematopoietic colony-stimulating factor. It is suggested that this culture technique may serve as a source of naive macrophages which are not exposed to lymphokines, undefined and possibly cross-reacting antigens, or other inflammatory mediators present in vivo which may alter macrophage functions. (PCS)

14376 (UCD—472-125, pp 100) **Effect of copper on lectin-induced lymphocyte proliferation.** Shifrine, M.; Taylor, N.J.; DeRock, E.W.; Wiger, N.; Fisher, G.L. Oct 1979.

In Annual report, 1978-1979.

To measure the effect of copper on the immune response, we used the whole blood lymphocyte stimulation test (WB/LST) which is an in vitro corollary of in vivo cell mediated immunity, as well as the mixed lymphocyte culture (MLC). Copper was found to inhibit lymphocyte division at doses of about 1 μg per 10^6 lymphocytes (50% inhibition) depending on the test used. Total inhibition of lymphocyte blastogenesis was seen with about 10 μg per 10^6 lymphocytes.

MICROORGANISMS

14377 (LA—8099-MS) **In vitro mutagenicity testing. II. Silastic 386 Foam Elastomer, Irganox 1010, mixture of Sylgard 184 with Encapsulating Resin and Curing Agent, and dimethylbenzanthracene.** Wang, S.Y.; Smith, D.M. (Los Alamos Scientific Lab., NM (USA)). Feb 1980. Contract W-7405-ENG-36. 6p. Dep. NTIS, PC A02/MF A01.

Four materials, Silastic 386 Foam Elastomer, Irganox 1010, Sylgard 184 with Encapsulating Resin and Curing Agent, and 7,12-dimethylbenzanthracene (DMBA), were tested for in vitro mutagenicity by the Ames Salmonella assay method. Silastic 386 Foam Elastomer, Irganox 1010, and Sylgard 184 Encapsulating Resin with Curing Agent were not mutagenic; the mutagenicity of DMBA was corroborated.

14378 (UCD—472-125, pp 44-47) **Analysis of variation in Ames testing of coal fly ash.** Lammert, J.; Chrisp, C.E. Oct 1979.

In Annual report, 1978-1979.

The Ames pour plate test was designed to be a qualitative test for the detection of mutagens. The degree of variation between different solvents, different batches of horse sera, and metabolic activation is discussed. Variation of results between test days was shown to be important.

14379 (UCD—472-125, pp 48-50) **Physical factors affecting the mutagenicity of coal fly ash.** Fisher, G.L.; Chrisp, C.E.; Raabe, O.G. Oct 1979.

In Annual report, 1978-1979.

The finest, most respirable fly ash fractions collected from the smokestack of a power plant were the most mutagenic for histidine-requiring auxotrophs of Salmonella typhimurium. Plant electrostatic precipitator ash samples were not mutagenic. The mutagens in coal fly ash were resistant to x-ray or ultraviolet irradiation, possibly due to stabilization by fly ash surfaces. Heating experiments indicated that all mutagenic activity is lost with heating to 350°C.

PLANTS

REFER ALSO TO CITATION(S) 13519, 14154

14380 (PB—295988) **Physiological and biochemical effects of air pollutants on soybean plants. Final report.** Biswas, P.K. (Tuskegee Inst., AL (USA)). May 1979. Contract EPA-R-800170. 76p. NTIS PC A05/MF A01.

The objective of this study was to determine the effects of NO2 and SO2 on soybeans which may cause irreversible damage. The effects of NO2 and SO2 on total protein, RNA, DNA and protein synthesis were determined. Also, the effects of NO2 on alpha-amylase, acid phosphatase, peroxidase and lipase were studied.

VERTEBRATES

REFER ALSO TO CITATION(S) 13117, 14262, 14268, 14347, 14348, 14374, 14386

14381 (PB—291657) **Health hazard evaluation determination report 77-56-467, Johns-Manville Products Corporation, Pittsburg, California.** Okawa, M.T.; Apol, A.G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1978. 20p. NTIS, PC A02/MV A01.

An investigations was made to determine whether fibrous glass used in the production of asphalt shingles is toxic in the concentrations used. For purposes of completeness, environmental evaluations of worker exposure to some of the other materials in the workplace such as asbestos crystalline silica formaldehyde and asphalt (petroleum) were made. The methods for the evaluation of the work environment varied depending upon the substance being sampled. No medical investigation was made. Employees working in and around the shingle manufacturing line are not exposed to excessive levels of fibrous glass. The slateman is exposed to potentially toxic levels of dust containing crystalline silica. Employees entering the saturator are exposed to potentially high levels of benz(a)pyrene. Employees exposures to asphalt fumes could not be adequately characterized to make a definite conclusion concerning toxicity with the currently available sampling and analytical techniques. Employees' exposures to formaldehyde, aromatic hydrocarbons, and total aliphatic hydrocarbons are not toxic.

14382 (UCD—472-125, pp 2-8) **Generation of fly ash aerosols for exposure of rats and monkeys.** Raabe, O.G.; McFarland, K.D.; Tarkington, B.K. Oct 1979.

In Annual report, 1978-1979.

Techniques have been developed for the laboratroy generation of aerosols of power plant fly ash from coal-burning power plants. Size-classified fly ash particles smaller than 5 μm in aerodynamic diameter were dispersed with a Wright dust feed mechanism in combination with a cyclone separator and ^{85}Kr discharger. During a 180-day exposure period, aerosols with mass concentration averaging 4.2 mg/cm^3 were generated into a 3.5 m^3 exposure chamber suitable for exposure of rodents or nonhuman primates. Aerodynamic size distributions determined with a cascade impactor had an average mass median aerodynamic diameter of 1.98 μm (0.02 μm SE), with an average geometric standard deviation of 1.65 (0.02 SE).

14383 (UCD—472-125, pp 59-61) **Comparative nasopharyngeal anatomy for aerosol inhalation deposition evaluation.** Schreider, J.P.; Raabe, O.G. Oct 1979.

In Annual report, 1978-1979.

Silicone rubber corrosion casts were prepared from the respiratory tracts of beagle dogs, rats, and a rhesus monkey. Special attention was paid to the morphometry of the nasal regions of these animals. The morphometry of the nasal regions of these species is compared and contrasted with respect to the effects of nasal deposition of airborne particles.

14384 (UCD—472-125, pp 62-64) **Quantification of inhaled fly ash in rat lungs.** Silberman, D.; Fisher, G.L.; Raabe, O.G.; Last, J.A. Oct 1979.

In Annual report, 1978-1979.

A technique is described for the quantification of inhaled fly ash. After lung burdens of chronic inhalation of laboratory-generated fly ash aerosols for up to 90 days, the aluminum content of rat lung was determined by atomic absorption spectrophotometry. Calculation of deposition fractions for inhaled fly ash based on fly ash burdens calculated from aluminum analysis were in agreement with expected values.

14385 (UCD—472-125, pp 65-69) **Effects of acute inhalation of fly ash and silica to C57BL/6 male mice.** Fisher, G.L.; Wilson, F.D.; Bradley, E.W. Oct 1979.

In Annual report, 1978-1979.

Studies were performed to evaluate the effects of fly ash and silica inhalation exposures on macrophage function and progenitors. Mice, C57BL/6, were acutely exposed to fly ash or silica aerosols and sacrificed 2, 6, and 15 days later. Macrophage phagocytosis was significantly depressed 6 and 15 days after exposure. Although macrophage colony formation was also initially depressed at day 2, markedly enhanced colony formation was observed at day 15. No significant effects were observed on granulocyte-monocyte progenitors from either spleen or bone marrow.

MAN

REFER ALSO TO CITATION(S) 13048, 14160, 14191, 14268, 14428, 14429, 14430, 14431, 14432, 14433, 14434, 14435, 14436, 14437, 14438, 14439, 14440, 14441

14386 (UCID—18222-79-1) **Sperm shape abnormalities induced by energy-related hydrocarbons and industrial chemicals. Progress report, January 1-June 30, 1979.** Wyrobek, A.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jul 1979. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

Using existing and new biological screening and testing systems, the presence of carcinogenic, mutagenic, teratogenic and physiologic or metabolically toxic agents associated with coal and oil shale extraction, conversion or utilization was identified. The purpose of the study is to further develop and apply the detection of morphologically abnormal mammalian sperm as a rapid, simple, quantitative assay of the pathologic response of the male gonad to toxic agents associated with the recovery, process stream, and emission of nonnuclear sources of energy, with primary attention to substances from in situ coal gasification and in situ oil-shale extraction. Changes in mouse sperm head dimensions following low dose x-ray exposure have been compiled and analyzed.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

REFER ALSO TO CITATION(S) 14237

14387 (N—79-17523) **Effect on mice of microwaves in the nonthermal intensity region. Respiration, rectal temperature, and mental reaction.** Criborn, C.O. (National Defense Univ., Washington, DC (USA). Research Directorate). Jan 1978. 23p. NTIS, PC A02/MF A01.

The effect of microwaves (2450 MHz) on respiration, rectal temperature and mental reaction to sound was studied using an intensity of 10 mW/sq cm for 30 minutes. The result shows that both respiration and reaction to sound deteriorated during exposure, while the rectal temperature was unaffected. Previous investigations carried out in the same way but at an intensity of 100 mW/sq cm for three minutes provided the opportunity to study the relationship between doses for two different intensities and a total dose of 300 mW.min./sq cm. It is shown that initially the respiration volume per minute decreases during exposure at both intensities, but that thermoregulation is cut out after approximately two minutes' exposure at 100 mW/sq cm; this leads to a rise in rectal temperature. At 10 mW/sq cm the rise in temperature is counteracted throughout the exposure period by a decrease in the respiration volume per minute. The value of the reaction to sound, normalized to the respiration volume per minute, is affected at both intensities.

14388 (PB—292067) **A comparison of measurement techniques to determine electric fields and magnetic flux under ehv overhead power transmission lines.** Lambdin, D.L. (Environmental Protection Agency, Las Vegas, NV (USA). Office of Radiation Programs). Mar 1978. 22p. NTIS, PC A02/MF A01.

Comparison is made between techniques used by the U.S. and reportedly used by the U.S.S.R. to measure electric field strengths under a 500 kV overhead power transmission line. Magnetic flux measurements were also made. Two instruments and three geometries were used in the electric field strength portion of the study. Maximum differences were noted when the measuring instrument was positioned close to the observer and at 1.8 meters above the ground as compared to one to two meters from the observer.

14389 (PNL-SA—7218(Rev.)) **Health aspects of power transmission.** Phillips, R.D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1979. Contract EY-76-C-06-1830. 17p. (CONF-7903107—1). Dep. NTIS, PC A02/MF A01.

From Symposium on energy and human health: human costs of electric power generation; Pittsburgh, PA, USA (19 Mar 1979).

Portions of document are illegible.

Exposure of rats and mice to 60-Hz electric fields at 100 kV/m for up to 120 days had no statistically significant, reproducible effects on a number of measures of metabolic status and growth, bone growth and structure, reproduction, hematology and serum chemistry, endocrinology, cardiovascular function, nerve function, or organ and tissue morphology. An effect on cell-mediated immunity was detected and is being evaluated further in additional experi-

ments. Exposure of rats in utero (day 0 of gestation to 8 days of age) had a transient effect at 14 days of age on motile behavior and development of the righting reflex. Significant effects were observed in synaptic transmission and behavior. Exposure to 60-Hz electric fields may increase the excitability of the nervous system of rats. Experiments are in progress to obtain a better understanding of these effects and their potential consequences.

14390 Biological effects of 60-Hz electric fields on miniature swine: exposure facility. Kaune, W.T.; Allen, C.H.; Beamer, J.L.; Decker, J.R.; Gillis, M.F.; Phillips, R.D.; Richardson, R.L. pp 9p, Paper F 79 693-3 of 1979 IEEE summer power meeting. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From 1979 IEEE summer power meeting; Vancouver, Canada (Jul 1979).

A facility for the exposure of miniature swine to vertical, 60-Hz, 30-kv/m electrical fields has been constructed. Exposed and sham-exposed colonies of swine are housed in separate, environmentally equivalent buildings. The electric field uniformity over the area of a swine stall is ;plus or minus;2.5% at ground-level and ;plus or minus;8% at the maximum height of a swine. The swine are not subject to spark discharges. The current between a drinking swine and its water nozzle is less than 20 ;mu;a. No levels of audible noise, hum, vibration, or ozone attributable to the high-voltage system have been detected. The total electric field harmonic distortion is 0.5%. 25 refs.

14391 Field determinations of HVDC ozone production rates. Droppo, J.G. pp 7p, Paper F 79 701-4 of 1979 IEEE summer power meeting. New York, NY; Institute of Electrical and Electronics Engineers (1979).

From 1979 IEEE summer power meeting; Vancouver, Canada (Jul 1979).

The environment near a high voltage direct current (HVDC) transmission line experiences corona effects, including the production of oxidants. Field determination of ozone production rates were made at the Bonneville Power Administration (BPA) HVDC Test Facility, The Dalles, Oregon, in fall and winter 1977. A novel micrometeorological profiling technique was used to identify sources of ozone plumes. The results indicate that even during precipitation the atmospheric ozone concentrations from HVdc lines at voltages up to ;plus or minus;550 kv are relatively small. Measured atmospheric ozone concentration plumes are consistent with laboratory data predictions of ozone concentrations based on corona, line parameters, and ambient dispersion. This confirmation under worst-case field conditions demonstrates the validity of previous estimates of a very low magnitude of the potential ozone effects. 17 refs.

14392 Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979). 593p. (CONF-781016—). NTIS $10.50.

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

The purpose of the symposium was to assemble researchers in the ELF bioeffects community to present and discuss recent results of experimental and theoretical work dealing with exposure system design, field interactions with living matter, biological and ecological effects, epidemiological surveys, and engineering field studies of relevance to the exposure of man and his environment to ELF fields. For this purpose we defined extremely low frequency fields as electric, magnetic, or electromagnetic fields ranging in fundamental frequency from 0 to 100 Hz. The intent was to emphasize research that could be directly related to exposures associated with contemporary or planned systems for energy production, transmission, and use. We also invited papers on more fundamental research to encourage scientific inquiry into mechanisms by which ELF fields of insensible intensity might interact with living materials to alter biological function.

14393 Human responses to power-frequency exposures. Michaelson, S.M. (Univ. of Rochester, NY). pp 1-20 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

A review of the literature indicates that most research on possible health effects of electric and magnetic fields on man has comprised (1) clinical studies of longitudinal or cross-sectional design or (2) isolated studies on human volunteers. In the former, relatively small groups of workers have been clinically examined and investigated for a variety of physiological parameters and for signs and symptoms of disease, either on a one-time prevalence basis or longitudinally over a period of time. The selection of questions, clinical examinations, and laboratory investigations has been influenced by pragmatic or theoretical considerations, often reinforced or complemented by published observations that have been made on small numbers of volunteers or animals under experimental conditions of exposure. In general, the studies were limited, lacked statistical power, and were oriented toward particular end results, e.g., comprehensive medical examinations in some cases in contrast to the special sensitivity of a particular body system, i.e., the central nervous system. Many of the reported studies present serious difficulties because pertinent material is not presented and in many cases the data are variable and internally inconsistent. Careful review of the information that is available, however, indicates that if a hazard does exist, it is not from the electric field per se, but from the secondary shock.

14394 Human considerations in bioeffects of electric fields. Mehn, W.H. (Commonwealth Edison Co., Chicago, IL). pp 21-37 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

Numerous studies have been reported which include the use of the human as an experimental model in determining biological effects of electric fields. Studies of various parameters examined have yet to demonstrate any effect from field strengths now in use in industry. Human experimentation is not possible in the United States; therefore we depend upon reports from those foreign countries where such studies can be done. Visits to the laboratories of numerous investigators in Europe have been made, and a summary of their data is given. In addition, epidemiological studies now under way in Europe and the United States are discussed, and the parameters to be evaluated are listed. An epidemiological study to be conducted as part of a United States - Soviet Russia agreement in the fields of extra-high-voltage (EHV) and ultrahigh-voltage (UHV) transmission is presented in some detail.

14395 Evaluation of responses of electrical utility companies to electromagnetic radiation questionnaire. Holt, G.L. (Tennessee Valley Authority, Muscle Shoals, AL). pp 38-41 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

During the spring of 1978, a questionnaire was mailed to over 600 electrical utility companies in the United States and Canada. The questionnaire requested information concerning employee complaints of health problems associated with working in or near the electromagnetic fields generated by electrical transmission lines and switchyards. Preliminary results of scanning the initial 226 replies indicated there have been very few health complaints from employees who must work near electromagnetic fields. There also appears to be very little use of personal protective equipment designed to reduce the electromagnetic field to which employees are exposed. A detailed evaluation of the information contained in the responses to the questionnaire is presented.

14396 Environmental effects of 765-kV transmission lines. Scott-Walton, B.; Clark, K.; Holt, B.; Jones, D.C.; Kaplan, S.; Krebs, J.; Polson, P.; Shepherd, R.; Young, J. (SRI International, Menlo Park, CA). pp 42-54 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

SRI International reviewed the testimony given before the New York State Public Service Commission in the two recent cases on the potential environmental effects of 765-kV overhead alternating-current transmission lines. The testimony focused on the potential effects of audible noise, on the potential biological effects of the electromagnetic fields, on the potential for electrical shocks to people who touch vehicles parked under the proposed lines, on the potential effects of the electromagnetic fields on electronic cardiac pacemakers, and on the potential effects of ozone produced by corona discharge from the lines. The testimony fully explored these questions; however, it did not resolve all of them. Because the testimony on the technical issues occupied 15,000 pages and because of the controversies among expert witnesses, the Department of Energy asked a multidisciplinary team at SRI International to review the testimony, clarify issues raised, resolve technical questions that remained unanswered, if possible, and to recommend research to resolve data deficiencies.

14397 Electric and magnetic fields as considerations in environmental studies of transmission lines. Lee, J.M. Jr. (Bonneville Power Administration, Portland, OR); Bracken, T.D.; Rogers, L.E. pp 55-73 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

The possible biologic effects of transmission-line electric and magnetic fields have received considerable attention from the public and the scientific community. A number of laboratory and environmental studies have been initiated in recent years to obtain information on this subject. Effects of these fields on plants and animals in natural environments should be considered in relation to effects due to transmission-line construction and maintenance activities. Except in a few cases, effects of electric and magnetic fields are subtle, whereas effects from construction and maintenance can cause severe impacts on plants and animals, including direct mortality. In environmental studies, effects of electric and magnetic fields must be considered in light of the amount and duration of exposure received by various species. The possible long-term physiologic effects of electric and magnetic fields on animals and humans are more properly investigated with controlled laboratory studies.

14398 Effects of high-voltage transmission lines on honeybees. Greenberg, B.; Kunich, J.C.; Bindokas, V.P. (Bioconcern, Chicago, IL). pp 74-84 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

For the study of possible bioeffects from extremely high voltage transmission lines, honeybees were hived under a 765-kV transmission line (electric field, 6.5 to 7.2 kV/m) in conventional metal-containing hives and in metal-free hives, both shielded and unshielded. Control hives were placed 400 m from the right-of-way where electric fields were 10 to 12 V/m. Bees in unshielded hives underneath the line were affected in several ways, with the effects more pronounced in metal-containing hives; e.g., hive weight gain was almost zero ($p < 0.005$) owing to a near absence of honey; the honey had a lower moisture content ($0.025 < p < 0.05$); bees weighed less ($p < 0.01$); hive entrances were excessively but not completely propolized; fewer pupae ($p < 0.01$), but normal numbers of eggs, larvae, and queen cells were produced; and all hives failed to survive the winter. In the metal-free group, the normal features were hive weight gain, bee weight, honey moisture content, and numbers of eggs, larvae, pupae, and queen cells. The abnormal features were propolization of hive entrances (but at a slower rate and lesser extent than in metal-containing hives), aggressive clusters at lower-front-hive corners, poor overwintering survival (78% mortality compared with 14% in shielded counterparts underneath the line and 9% among the ones in the control area), and possibly higher hemocyte counts.

14399 Exposure of personnel to electric fields in Swedish extra-high-voltage substations: field strength and dose measurements. Loevstrand, K.G. (Uppsala Univ., Sweden); Lundquist, S.; Bergstroem, S.; Birke, E. pp 85-92 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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An investigation has been conducted on the biological effects of accumulative exposure to electric fields of personnel in Swedish extra high voltage (EHV) substations. A dosimeter was constructed for determination of exposure to 50-Hz electric fields. This instrument measures the time of exposure to field strengths above 5, 10, and 15 kV/m, respectively, by each of three channels. Several work operations were investigated, such as servicing breakers and disconnectors, regular inspection rounds in substations, and testing of insulator elements. The electric field strengths at the work sites were mapped with a dipole-type field strength meter. Many of the operations studied gave lower exposures for the dose measurements than had been expected. Work conducted on top of circuit breakers close to hot phases, however, gave high exposure values.

14400 Monitoring of personnel exposed to a 60-Hz electric field. Deno, D.W. (General Electric Co., Pittsfield, MA). pp 93-108 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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The exposure of a person to electric fields from transmission lines and substations can be characterized by the time histograms of the electrical quantities related to the unperturbed electric field. Among these quantities the surface current density in any one of a number of locations on the upper part of the body was found to be suitable to represent the induction in people. An electric field exposure monitor was constructed to measure the time integral of the unperturbed field in the ranges of 0 to 5 kV/m, 5 to 10 kV/m, and above 10 kV/m. A separate readout device discharges the integrators and reads out the doses after the exposure period, such as one day, one week, or one month. For practical use a monitor mounted on a hard hat or on an armband is adequate for measuring electric field exposure. Practical tests for outdoor conditions indicate performance accuracy of approximately +-10%. The values of individual exposure of people in high-voltage installations were measured. These exposures are much lower than the maximum exposure that could be obtained by multiplying the electric field strength in the area of work by the total time of exposure. Measurements of field exposure can be translated into measurements of exposure to alternating currents.

14401 60-Hz electric field parameters associated with the perturbation of an eukaryotic system. Miller, M.W.; Carstensen, E.L.; Kaufman, G.E.; Robertson, D. (Univ. of Rochester, NY). pp 109-116 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Roots of Pisum sativum were exposed for 7 days to 60-Hz electric fields ranging from 70 to 430 V/m in an aqueous medium whose conductivity was approximately to 0.07 S/m. (Corresponding current densities in the exposure medium associated with these field strengths ranged from 0.5 to 3.0 mA/cm^2). Control and exposed roots were grown concomitantly in the same tank, where the growth medium was continuously circulated. Temperature in the exposure medium was held at a constant 19 +- °C. All experiments were double-blind. Root growth rates were determined daily. No reductions in root growth were observed with electric fields of ~ 140 V/m. There was a slight effect at 360 V/m, and a pronounced decrease in growth rate occurred at 430 V/m. Comparable fields could not be obtained by exposure of the medium through air because the required fields would exceed the dielectric strength of air. Under conditions in which growth inhibition occurs, it is estimated that induced 60-Hz cell membrane potentials would be of the order of 5 mV.

14402 Effects of extremely low frequency fields on slime mold: studies of electric, magnetic, and combined fields, chromosome numbers, and other tests. Greenebaum, B.; Goodman, E.M.; Marron, M.T. (Univ. of Wisconsin, Kenosha). pp 117-131 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Statistical studies of data from additional measurements of mitotic cycle length and respiration rate of the slime mold Physarum polycephalum indicate that the changes in both parameters induced by 75-Hz continuous-wave fields of 2.0 G (1 G = 10^{-4} T) and 0.7 V/m are significantly different in magnitude from the changes induced by applying either field independently or by applying simultaneously fields of one-fifth the strength. Application of modulated fields of three different strengths produces effects of essentially the same size. Inferences about characteristics of the mechanism of interaction are drawn on the basis of these observations. Experiments are also reported which refute hypotheses that earlier observations of effects were due either to the lack of blind scoring of mitosis or to electrical contact between metal electrodes and the medium. Finally, indirect measurements of chromosome numbers are presented which show that any difference in chromosome numbers in this polyploid organism induced by exposure to the fields is less than 6% ($p < 0.05$).

14403 Firing-pattern changes and transmembrane currents produced by extremely low frequency fields in pacemaker neurons. Wachtel, H. (Duke Univ., Durham, NC). pp 132-146 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Using microelectrode techniques, we examined the response of pacemaker neurons to extremely low frequency (ELF) currents injected into the cell as well as their response to ELF fields. The minimum thresholds were seen for one-to-one synchronization of the neuronal firing rate by the ELF transmembrane or the field current (0.6 nA for the former and 2.0 $\mu A/cm^2$ for the latter). In the case of the field current, the threshold was highly dependent on the direction of the current with respect to the neuronal orientation. The transmembrane current density calculated from estimates of cell-membrane area averaged about 1% of the field current density needed to produce the equivalent effect on the neuronal firing pattern.

14404 Role of cell surface polarization in biological effects of extremely low frequency fields. Sheppard, A.R.; Adey, W.R. (J.L. Pettis Memorial Veterans Administration Hospital, Loma Linda, CA). pp 147-158 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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A physical mechanism to explain recent reports of neurochemical and behavioral effects of extremely low frequency fields at the cellular level must lead to significant molecular changes initiated by fields far weaker than 1 mV/m. The very large, low-frequency polarization of cells may be attributed to polarization of a sufficiently dense counterion cloud located near the anionic membrane glycolipids and glycoproteins of the membrane surface. Counterion polarization occurs on the membrane surface and is distinct from transmembrane polarization. In the analysis of surface-charged spheres, Schwarz and others have successfully described the size and frequency dependence of low-frequency polarization in colloidal polystyrene or resin spheres. We apply that model to consider the polarization of long, thin neural processes such as dendrites of brain tissue in fields parallel or perpendicular to the long axis. The effect of the polarization on the dynamics of weakly bound ions suggests ways in which certain ions may have greatly reduced momenta and thus participate in quantum behavior (such as tunneling), which, under normal circumstances, is not possible for such massive entities.

14405 Design of exposure systems for studying the biological effects of 60-Hz electric fields on small plants and animals. Poznaniak, D.T. (Westinghouse Electric Corp., East Pittsburgh, PA); Johnson, J.G.; McKee, G.W.; Graves, H.B. pp 159-171 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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This paper is intended as a descriptive prelude to companion papers that report actual experimental results. As such, the reasoning, logic, and technical approaches used in designing the exposure systems for small animals and plants are delineated. The results of analytical studies on present and prototype transmission-line configurations are briefly discussed to establish experimental exposure levels and orientation. Techniques used in designing the electrode system and in verifying the accuracy of the exposure environment are also described. Emphasis is placed upon guidelines regarding subject size and attendant field enhancement which have been implemented in the studies. Finally, some exposure-system design specifics, operation criteria, and verification test results are addressed.

14406 Prediction of damage severity on plants due to 60-Hz high-intensity electric fields. Johnson, J.G. (Westinghouse Electric Corp., East Pittsburgh, PA); Poznaniak, D.T.; McKee, G.W. pp 172-183 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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In experimental studies involving 85 species of small plants exposed to 60-Hz high-intensity electric fields, it was found that plant tissue-damage severity was dependent upon leaf-tip geometry and morphology. Fleshy, rounded, or blunt plant parts showed no damage in 50 kV/m fields, whereas plant parts with a pointed shape exhibited minor damage at field intensities of 20 to 22 kV/m. The rate of tissue damage development decreased with time such that total tissue damage achieved a finite limit. This limit was directly proportional to electric field intensity. Tissue damage was observed to have the same electric field inception level as visible corona discharges about the damaged parts. Utilization of Peek's law for partial electric breakdown in nonuniform fields has resulted in a technique for predicting the extent of tissue damage on a given species.

14407 Biological effects of 60-Hz alternating-current fields: a Cheshire cat phenomenon. Graves, H.B. (Pennsylvania State Univ., University Park); Long, P.D.; Poznaniak, D. pp 184-197 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Most studies on biological effects of extremely low frequency (ELF) fields involve relatively small groups of animals, and current data suggest that the magnitude of biological effects of ELF exposure is small or nonexistent, even when imposed field strengths are large. Hence, true differences between treatment groups will often be undetected, and one should expect that occasional statistically significant differences will occur when true differences between treatment groups do not exist. Results of integrated studies on several elements of the system being evaluated may therefore be more instructive than isolated sutides on unrelated dependent variables. For example, studies on blood cell composition changes due to ELF exposure in our laboratories seem to exhibit random patterns of differences; by contrast, results of integrated studies on growth, perception, and endocrine responses suggest nonrandom patterns of differences in response to high-intensity ELF exposure.

14408 Exposure and data-collection facilities for circadian studies of electric field effects upon behavior, thermoregulation, and metabolism in small rodents. Ehret, C.F.; Sacher, G.A.; Langsdorf, A.; Lewis, R.N. (Argonne National Lab., IL). pp 198-224 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Design and construction of facilities to investigate the effects of extremely low frequency electromagnetic fields on circadian and intradiel aspects of behavior, metabolism, activity, and thermoregulation in rats and in mice are described. The basic exposure facility consisted of circular parallel-plate electrodes separated by a distance of 30.5 cm. Fields were held uniform by a set of three guard hoops or rings spaced between the electrodes. Animals were exposed in cages of glass or of plastic in either a horizontal or a vertical orientation to the field. Miniprobe measurements of field strengths within the cages revealed that the fields were highly uniform, homogeneous, and reproducible from cage to cage. Since the presence of an animal within a cage disturbs the field homogeneity appreciably, measurements of total body current within exposed animals were made, and their correspondence to animal posture and orientation is discussed. Circadian rhythms and metabolic parameters were measured in these environments.

14409 Prototype system for exposing small laboratory animals to 60-Hz vertical electric fields: electrical measurements. Kaune, W.T. (Battelle Pacific Northwest Labs., Richland, WA). pp 225-240 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Two horizontal, planar 1.0- by 1.8-m parallel metal electrodes were spaced 0.58 m apart and placed in a 3.5- by 3.7-m grounded metal-screen enclosure. The upper electrode was energized and the lower grounded. The capacitance between the two electrodes was 41 pF, and between the upper electrode and the metal-screen enclosure, 68 pF. The electric field was 97% of the ideal parallel-plate value at the center of the lower electrode and was uniform to within 7.5% over a 0.5- by 1.0-m area of the lower electrode surface; over this area the estimated horizontal field components 10 cm above the lower electrode surface were less than 3% of the vertical component. The presence of a grounded wall close to the electrodes adversely affected field uniformity, but energizing both electrodes with equal magnitude but oppositely phased voltages minimized wall-electrode interaction. A 4.8-mm-thick plexiglass sheet placed 10 cm above the lower electrode increased the floor-level field strength by 1%. A plexiglass wall 10 cm high and 4.8 mm thick reduced the field strength at its base by 2.5%.

14410 1000-kV project: research on the biological effects of 50-Hz electric fields in Italy. Cerretelli, P. (Univ. of Milan, Italy); Veicsteinas, A.; Margonato, V.; Cantone, A.; Viola, D.; Malaguti, C.; Previ, A. pp 241-257 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Studies on the biological effects of electric fields on laboratory animals (mice, rats, rabbits, and dogs) have been carried out in Italy within the 1000-kV project, an international research program on ultrahigh voltage (UHV) transmission. Electric fields were induced between two 1.5- by 2-m steel plates. The bottom plate, on the floor of a room, was grounded; and the energized electrode was hung above the grounded plate at a height that could be adjusted by means of pulleys. Thus the animals that were housed on the grounded electrode could be exposed to various field intensities, depending on the distance between the plates and the applied voltage. Exposures lasting from 30 sec to 8 hr/day to 50-Hz electric fields of up to 100 kV/m were carried out over periods of up to 2 months. Basic cardiovascular variables (i.e., blood pressure, electrocardiogram, heart rate, and cardiac output), blood morphology and chemistry, growth and fertility, teratology, and changes in resistance to induced infections were investigated.

14411 Power frequency electric fields and biological stress: a cause-and-effect relationship. Marino, A.A. (Veterans Administration Medical Center, Syracuse, NY); Cullen, J.M.; Reichmanis, M.; Becker, R.O. pp 258-276 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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To test the specific hypothesis that a 60-Hz electric field of 5000 V/m can be a biological stressor, we performed fibular frac-

tures on a number of rats; one-half the group was exposed to the field and half was maintained as a control. The rats were housed individually in totally plastic enclosures. Both food and water were supplied on essentially the same equipotential plane as that occupied by the animals. The fractures were performed at the midshaft, and the extent of healing was assayed 14 days thereafter on the basis of blind scoring of serial histological preparations. At 14 days after fracture, the degree of healing manifested by the exposed animals was substantially less than that of the unexposed animals. The entire experiment was repeated; there were identical results. When rats were exposed at 1000 V/m in two replicate experiments, however, no differences were seen in the degree of fracture healing. We conclude that a 60-Hz electric field of 5000 V/m has been shown to be a biological stressor in the mammalian system we used.

14412 Effects of chronic exposure to a 60-Hz electric field on synaptic transmission and peripheral nerve function in the rat. Jaffe, R.A.; Phillips, R.D.; Kaune, W.T. (Battelle Pacific Northwest Labs., Richland, WA). pp 277-296 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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The purpose of this study was to investigate the effects of chronic (30-day) exposure of rats to a 60-Hz, 100 kV/m electric field on synaptic transmission and peripheral nerve function. Superior cervical sympathetic ganglia, vagus nerves, and sciatic nerves were removed from urethane-anesthetized rats after sham or electric-field exposure in the parallel-plate exposure system developed at Pacific Northwest Laboratory. The nerves or ganglia were placed in a temperature-controlled chamber and continuously superfused with a modified mammalian Ringer's solution equilibrated with 95% O_2 and 5% CO_2. Several parameters and tests were used to characterize synaptic transmission and peripheral nerve function. These included amplitude, area, and configuration of the postsynaptic or whole-nerve compound action potential; conduction velocity and synaptic delay; accommodation; refractory period; strength vs. duration curves; conditioning-test response; frequency response; posttetanic response; and high-frequency-induced fatigue. Results thus far obtained (increased C-fiber conduction velocity, decreased rate of fatigue, and shifts in strength vs. duration and conditioning-test response curves) suggest that such electric field exposures may increase neuronal excitability. Replicate studies are currently under way.

14413 Clinical pathologic evaluations in rats and mice chronically exposed to 60-Hz electric fields. Ragan, H.A.; Pipes, M.J.; Kaune, W.T.; Phillips, R.D. (Battelle Pacific Northwest Labs., Richland, WA). pp 297-325 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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From evaluation of a large number of hematologic and serum chemistry parameters, there appear to be no unequivocal hematologic or serum chemistry effects on rats and mice exposed to unperturbed field strengths of 100 kV/m for 15, 30, 60, or 120 days. Statistically significant differences between exposed and sham-exposed rats and mice were seen but failed to replicate in subsequent experiments.

14414 Immunological studies with 60-Hz electric fields. Morris, J.E.; Ragan, H.A. (Battelle Pacific Northwest Labs., Richland, WA). pp 326-334 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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A series of experiments were conducted to measure effects of 60-Hz, 100 kV/m unperturbed electric fields on selected humoral and cellular components of the immune system of Swiss-Webster mice. There were no significant differences in serum immunoglobulins, complement levels, or distribution of T or B lymphocytes. However, a statistically significant difference was seen in leukocyte and lymphocyte levels between 60-day-exposed and sham-exposed mice, but these levels failed to replicate in subsequent experiments. The primary antibody response to keyhole limpet hemocyanin (KLH) was measured in mice exposed for 30 or 60 days. No significant effect was observed in the levels of precipitating antibody in exposed mice when compared to sham-exposed controls.

14415 Development toxicology studies with 60-Hz electric fields. Sikov, M.R.; Montgomery, L.D.; Smith, L.G. (Battelle Pacific Northwest Labs., Richland, WA). pp 335-347 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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A series of three replicated experiments were undertaken to determine the effects of exposure to uniform 60-Hz electric fields (100 kV/m) on reproduction and on fetal and postnatal growth and development in the rat. In the first experiment a six-day exposure, prior to and during mating, did not affect the reproductive performance of either males or females. Continued exposure of the mated females through 20 days of gestation did not affect the size or the morphology of the fetuses. A similar 30-day exposure of the males and of the unmated females did not affect their subsequent mating performance or fertility. In the second experiment exposure of the pregnant rat was begun on day 0 of gestation and continued until the resulting offspring reached eight days of age. The third experiment also involved a 30-day exposure, beginning at 17 days of gestation and continuing through 25 days of postnatal life. These 30-day exposures produced few statistically significant effects on the growth, survival, or neuromuscular development of offspring. The primary change was an accelerated development of motile behaviors. Tests of the reproductive integrity of the offspring of the second experiment did not disclose any deficits.

14416 Enhanced growth in pubescent male primates chronically exposed to extremely low frequency fields. Grissett, J.D. (Naval Aerospace Medical Research Lab., Pensacola, FL). pp 348-362 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Sixty rhesus monkeys were pair-matched by sex, age, and weight. One animal from each pair has been exposed 22 hr each day since 1975 to a magnetic field of 0.2 mT and, at the same time, to an electric field of 20 V/m. These fields were alternating at approximately 76 Hz. In addition to comprehensive examinations by a veterinarian every 6 weeks, weekly blood samples were drawn early in the morning with the animals in a fasting condition. To date, the most significant result is the difference in rate of weight gain between exposed and control males. The exposed males, which gained weight at a faster rate than did the control males, are about 10% heavier. Although well within clinically normal limits, levels of blood urea nitrogen, glucose, and gamma-glutamyl transpeptidase were lower in the exposed males than in the control males. At present all attempts to find an endocrine correlate that would account for sexual specificity have failed. It may be that the basis for the growth effect is not related to sex but only appears to be so in this experiment because of the difference in maturity at the beginning of exposure. The females were closer to their maximum somatic development at the beginning of exposure than were the males and may have been less susceptible to a stimulus that affects growth rate.

14417 System for the exposure of miniature swine to 60-Hz vertical electric fields: current status. Kaune, W.T.; Allen, C.H.; Beamer, J.L.; Gillis, M.F.; Miller, M.C.; Phillips, R.D. (Battelle Pacific Northwest Labs., Richland, WA). pp 363-378 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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In 1977 a large facility for exposing 40 miniature swine to 60-Hz electric fields was constructed at this laboratory. An overhead electrode of four parallel cylindrical conductors was built at a height of 4.6 m above a nonconducting exposure building constructed of a laminated fiberglass - polyurethane-foam material. A second building, not under the electrode, was built to house the control population. During construction and testing, small portions of the exposure building were contaminated with moisture and became electrically conducting; this resulted in large perturbations in the electric field and in the heating of parts of the building. Further study established that reliable long-term service from this building, if it were exposed to electric fields, could not be assured. A new grid electrode was built inside the exposure building, and the inside surfaces of the buildings were covered with metal screen that was electrically grounded; exposure of the building to the electric field was thereby prevented. The following results were obtained. The ground-level electric field is uniform to 5%. Enhancement of the electric field at the surface of a swine's body as a result of the lowered electrode height is less than 5%. No ozone concentrations above ambient background levels inside the building are generated by the energized electrode. There is no audible noise. The electric field total harmonic distortion is 0.5%.

14418 Magnetic field effects on humans: epidemiological study design. Budinger, T.F.; Wong, P.D.C.; Yen, C.K. (Univ. of California, Berkeley). pp 379-399 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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The design for a retrospective study on health effects of stationary and alternating magnetic fields on humans is presented. The study involves identification of 1000 exposed subjects and 1000 matched controls from eight facilities in North America, medical record encoding, estimation of magnetic field exposure by field measurements, computer modeling, exposure information questionnaires, and data analysis. Sample-size considerations based on disease incidence reveal that a change in incidence by a factor of 1.5 in cardiovascular disease or cancer will have to occur before we can conclude that there is a positive result in a study of this type.

14419 Response of agarose solutions to magnetic fields. Kalkwarf, D.R.; Langford, J.C. (Battelle Pacific Northwest Labs., Richland, WA). pp 408-416 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Gelation temperatures of aqueous 1.4% agarose solutions were found to increase with magnetic field strength from 37.4 +- 0.2°C at 0 T to 38.8°C at 1 T. The gels formed at 1 T were 7 +- 3% more permeable to high-molecular-weight deoxyribonucleic acid and had melting points that were 1.7 +- 1.0°C higher than gels formed at 0 T. The results indicate that agarose is selectively oriented in liquid solution by large magnetic fields and suggest that the same type of interaction may lead to magnetic effects in tissues rich in the structurally related mucopolysaccharides.

14420 In vitro evaluations of static magnetic fields. Frazier, M.E.; Andrews, T.K.; Thompson, B.B. (Battelle Pacific Northwest Labs., Richland, WA). pp 417-435 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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Experiments with cell cultures exposed to static magnetic fields ranging from 0.1 to 1.0 T were initiated in an attempt to determine whether there was a reproducible effect on cultured cells relative to cell viability, growth rate, cell size, morphology, and transformation. In one group of studies, several cell lines (frozen) were exposed to magnetic fields of either 0.5 or 1.0 T for 4, 8, or 24 hr; they were then thawed and grown in culture by standard tissue-culture techniques. No consistent effects on measured parameters were observed at magnetic fields up to 1.0 T for 24 hr. Additional investigations using a chronic-exposure system involved continuous exposure of mammalian cell cultures to 0.1 or 0.3 T for up to 20 passages (approximately 80 cell doublings) in culture. The plating efficiency, population doubling time, cell size, morphology, and viability of these cells were measured at several intervals. The differences observed in the colony-forming efficiency of cultures exposed to a 0.3-T magnetic field were the result of increased cell clumping rather than an inhibitory effect of magnetic fields on cell division.

14421 Effect of constant and alternating magnetic fields on tumor cells in vitro and in vivo. Chandra, S.; Stefani, S. (Veterans Administration Hospital, Hines, IL). pp 436-446 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

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The studies were undertaken to determine if constant or alternating magnetic fields could be used as a cancer therapy modality. Cultured cells established from a human bronchogenic carcinoma and from a Burkitt lymphoma were exposed to constant and alternating (60-Hz) magnetic fields. The strength of the field ranged from 0.1 to 1.0 T, and the duration of exposure was from 0.5 to 3 hr. A water-cooled 17.78-cm Magnion electromagnet with a maximum field strength of 1.15 T was used for constant magnetic fields (CMF), and a 1.5-cm electromagnet, designed in our laboratory for a maximum output of 0.22 T, was used as a source of both constant and alternating magnetic fields (AMF). Some cultures received a single exposure, whereas others were exposed daily for 3 days. The growth characteristics of these established cultures, as determined by counting the number of viable cells in a hemocytometer, were unaffected by exposure to CMF or to AMF. In vivo studies were made with a transplantable mammary tumor of the DBA/2 strain of mouse. The tumor was maintained by subcutaneous implantation of single-cell suspension or of minced tumor pieces. Tumor cells were exposed to magnetic fields either in vitro before implantation or in vivo after a suitable size of tumor nodule had developed. Both CMF's and AMF's were used. No regression or retardation in the growth of tumor was observed.

14422 Environmentally controlled system for exposure of mice to large direct-current magnetic fields. Decker, J.R. (Battelle Pacific Northwest Labs., Richland, WA); Kuffel, E.G.; Mahlum, D.D.; Sikov, M.R.; Harris, C.P. pp 447-461 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

The anticipated increase of exposure of man and his environment to large magnetic fields from fusion reactor development and other industrial magnetic-field applications has resulted in the initiation of studies on the biological effects of such fields in our laboratory and elsewhere. One series of our experiments required an exposure system in which large numbers of mice could be exposed for prolonged periods to vertically oriented direct-current magnetic fields of up to 1.5 T. It was necessary that the system be sufficiently versatile to allow exposures to uniform or gradient fields in either a continuous or a pulsed mode. It was determined that the bore of a beam-bending magnet, such as is used in high-energy physics experiments, would provide such fields, with suitable magnitudes and volumes. A life-support system was developed which would not interact with the magnetic field and which would obviate extraneous environmental factors that could interfere with interpretation of results. This paper describes the design and characteristics of this system which was used for collaborative experiments at the Stanford Linear Accelerator Center.

14423 Development of mice after intrauterine exposure to direct-current magnetic fields. Sikov, M.R.; Mahlum, D.D.; Montgomery, L.D.; Decker, J.R. (Battelle Pacific Northwest Labs., Richland, WA). pp 462-473 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

Studies were undertaken to examine the effects of magnetic field exposure of intrauterine mice on their subsequent prenatal or postnatal development. Gravid Swiss-Webster mice of known gestational age were exposed either to a uniform 1-T field or to a gradient (2.5 T/m) field with a maximum strength of 1 T. Experimental animals were housed in an environmentally controlled chamber within the bore of a beam-bending magnet, whereas sham-exposed control mice were housed under identical conditions in a nonenergized magnet. For prenatal evaluation, groups of mice were exposed during 1/2 to 7, 6 to 15, 10 to 18, or 1/2 to 17 (or 18) days of gestation (d.g.) and sacrificed at 18 d.g. Litter size, prenatal mortality, and fetal weights were determined; and the fetuses were examined for gross skeletal and visceral malformations. For postnatal evaluations other groups were exposed during 1/2 to 17 or 6 to 18 d.g; they were then transferred to standard plastic cages and allowed to deliver and rear their litters. The offspring were counted, weighed, and examined at birth and at several subsequent ages. Several measures of development and neuromuscular status were evaluated at regular intervals through 4 weeks of age, at which time the offspring were necropsied.

14424 Dominant lethal studies in mice exposed to direct-current magnetic fields. Mahlum, D.D.; Sikov, M.R.; Decker, J.R. (Battelle Pacific Northwest Labs., Richland, WA). pp 474-484 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

As part of the comprehensive program to systematically evaluate the effects of magnetic fields on biological systems, we investigated the possibility of induced genetic changes in mice by using the dominant lethal assay. Male Swiss-Webster mice were exposed to (1) a homogeneous 1-T field for 28 days, (2) a gradient field (2.5 T/m) for 28 days, or (3) an on-off ramped, gradient field for 42 hr. Control males were sham-exposed in a nonenergized magnet under otherwise identical environmental conditions. After exposure each male was caged with three unexposed virgin females. The females were replaced weekly and were killed 10 days after separation from the males. Breeding was conducted for 4 to 8 weeks. The number of viable fetuses and the incidence of resorptions were recorded for each female.

14425 Electrical parameters of the high-voltage direct-current transmission-line environment. Bracken, T.D. (Bonneville Power Administration, Vancouver, WA). pp 485-500 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

Ground-level electrical parameters for high-voltage direct-current (HVDC) transmission lines to +-600 kV are discussed and contrasted with electrical parameters for extra-high-voltage (EHV) alternating-current (a-c) transmission lines. The presence of corona-generated ions in the region surrounding direct-current (d-c) conductors enhances the nominal electric field caused by charge on the conductors alone. This space charge also produces charge and current densities in the interelectrode space. All three of these parameters are required to define the electrical environment of an HVDC transmission line, whereas the electric field is sufficient for a-c lines. Measurements of the electric field, the ion current density, and the charge density at ground level under the Bonneville Power Administration HVDC test line at The Dalles, Oreg., are presented. Typical values under low wind conditions for simultaneously measured field, ion current density, and charge density are 20 kV/m, 40 nA/m^2, and 12 nC/m^3, respectively. Levels of these parameters vary greatly, and emphasis is placed on the fluctuations associated with wind perpendicular to the line. Electrical effects associated with the d-c electrical environment are described and contrasted with the more familiar 60-Hz effects. Field perception, potential nuisance shocks, and steady-state d-c currents are considered.

14426 Ozone field studies adjacent to a high-voltage direct-current test line. Droppo, J.G. (Battelle Pacific Northwest Labs., Richland, WA). pp 501-529 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

The environment near a high-voltage direct-current (HVDC) transmission line experiences effects of the line operation. These effects are the result of the high voltage and the corona discharge on the conductors. One of these potential effects, the production of oxidants, was studied by Pacific Northwest Laboratory (PNL) in a cooperative field study with the Bonneville Power Administration (BPA). These tests were conducted at the BPA HVDC Test Facility at The Dalles, Oreg. Ozone was studied as a primary indicator of oxidant levels. Field studies included tracer tests, detailed ozone profile studies, and fixed-height ozone monitoring studies. Detailed micrometeorological data were taken during each test to define the ambient conditions. Tracer tests demonstrated that the trajectories from the conductors intersected the profile measurement tower. The profile tests provided data for definition of the ozone plumes from the energized test lines. The results indicate that even during precipitation the atmospheric ozone concentrations from HVDC corona are relatively small.

14427 Mutagenic effects of high-strength electric fields. Hungate, F.P.; Fujihara, M.P.; Strankman, S.R. (Battelle Pacific Northwest Labs., Richland, WA). pp 530-537 of Biological effects of extremely low frequency electromagnetic fields. Phillips, R.D.; Gillis, M.F.; Kaune, W.T.; Mahlum, D.D. (eds.). Washington, DC; Department of Energy (1979).

From 18. annual Hanford life sciences symposium; Richland, WA, USA (16 Oct 1978).

An exposure system has been developed for exposing small organisms to very large electric fields. Following exposures in 200 to 800 kV/m direct-current fields, significantly ($p = 0.01$) increased frequencies of mutant-type colonies were observed in the Ames Salmonella strain TA-100, which mutates by base exchange, and in Photobacterium fisheri (tested for resistance to tetracycline). No increased mutation was observed in Salmonella strain TA-98, which mutates by frameshift. Data on induction of sex-linked recessive lethal mutations in Drosophila are inconclusive.

HEALTH AND SAFETY

14428 (PB—291658) **Health hazard evaluation determination report no. 77-6-465, Allen-Bradley Company, Magnetics Division, Shawnee, Oklahoma.** Markel, H.L. Jr; Thoburn, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1978. 7p. NTIS, PC A02/MF A01.

An evaluation regarding the exposure of workers to lead in the powder house and wet/dry press areas in a facility involved in the production of ceramic permanent magnets has been conducted. A total of 15 workers in the powder house, wet/dry press area were privately interviewed by the industrial hygienist in a nondirected manner concerning any health problems thought to be related to their specific jobs at the plant. Twenty four breathing zone air samples were collected at a sampling rate of 1.7 liters per minute. Samples were analyzed for both total and respirable portions of lead by direct aspiration atomic absorption at a lower limit of detection of five micrograms per sample. It has been determined that employees performing duties in the powder house, as dry press operators and as wet press operators were not exposed to toxic concentrations of lead.

14429 (PB—291659) **Health hazard evaluation determination report no. 77-106-469, Fountain Foundry, Inc., Pueblo, Colorado.** Gunter, B.J.; Lybarger, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1978. 19p. NTIS, PC A02/MF A01.

An investigation to evaluate the potential exposures to lead, free silica and total particulate during the operation of a grey iron foundry has been performed. The foundry takes scrap metal (usually a mixture of cast iron and various other metal parts) and produces a molten metal from a furnace charged with coke and limestone. The molten metal is then poured into various types of sand molds, where products such as manhole covers are formed. Breathing zone air samples were taken for lead, free silica, and total particulate. A medical evaluation of 19 workers was also conducted. This evaluation included a medical history and physical examination with blood and urine biological tests. Two of 19 workers met the case definition for lead toxicity based on blood chemical analysis. Breathing zone air samples for lead exceeded recommended exposure criteria. Considerable exposure to total particulate containing free silica was also detected. It has been determined on the basis of medical and environmental evidence that a potential health hazard existed to workers exposed to lead and possible free silica at the Foundry during this evaluation.

14430 (PB—291662) **Health hazard evaluation determination report no. 77-77-464, Buckeye Automatic Company, McArthur, Ohio 45651.** Kronoveter, J.; Elesh, W.E. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Feb 1978. 10p. NTIS, PC A02/MF A01.

An evaluation to determine the consequences of exposure to cutting oils used in the manufacturing of screw machine produced parts for the automotive industry has been conducted. On the basis of environmental sampling and current toxicity information it is concluded that inhalation of oil mists did not pose a health hazard to the employees. However, the results of the medical interviews and examinations clearly showed a dermatitic hazard due to skin contact with cutting oils. Sixteen of twenty workers had cutting oil dermatitis in varying degrees, from slight to extreme. To alleviate and prevent the cutting oil dermatitis, recommendations for both workers and management are presented. The workers were educated in proper hygiene and self-examination practices during the study.

14431 (PB—291667) **Health hazard evaluation determination report no. 77-71-475, Westinghouse Air Brake Company, Wilmerding, Pennsylvania.** Gilles, D.; Stroman, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1978. 16p. NTIS, PC A02/MF A01.

An investigation of the two areas dealing with in core processing air brake manufacturing has been conducted. The process involves mixing two parts of an organic resin (Isocure I and II) with sand. This mixture is blown into core molds where the catalyst, triethylamine (TEA), is injected through the sand mixture. Air samples for TEA were obtained in the breathing zone of 13 workers and in selected areas of potential maximum concentration. A personal and area sample were also taken for the methylene chloride. Thirty-three employees were interviewed, examined and patch tested. Measured airborne concentrations of TEA and Methylene chloride did not exceed the recommended criteria on an 8 hour time-weighted average concentration basis. However, the TEA results are suspect. Patch testing revealed no allergic dermatitis among employees. However, examinations and medical histories revealed several employees who had contact dermatitis or other skin problems, such as severe defatting of the skin, which were felt to be work related. This was also supported by the observation of poor work practices among the employees.

14432 (PB—291668) **Health hazard evaluation determination report no. 78-14-476, Gerico, Inc., Boulder, Colorado.** Gunter, B.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1978. 7p. NTIS, PC A02/MF A01.

An investigation to evaluate the exposures to aluminum oxide and other oil mist produced by hot wire cutting of polypropylene webbing has been made. The subject manufacturer makes backpacks for carrying infants, folding baby strollers, and folding baby beds. These items are made from tubular aluminum and polypropylene webbing. During this evaluation, workers that were monitored included those working in cutting, sewing, riveting and handling and aluminum tubing. All workers were monitored in the areas where the aluminum tubing was being sewed, cut, riveted, and handled. Sound level measurements were taken throughout this area. Each worker was interviewed, and questions were directed at work history and specific medical complaints. All breathing zone air samples were collected on filters using vacuum pumps operated at 1.5 liters per minute. A health hazard did not exist to either aluminum oxide or oil mist at the time of the evaluation. High noise levels were observed in numerous areas of the plant.

14433 (PB—291669) **Health hazard evaluation determination report no. 78-29-478, U.S. Steel Corporation, Cuyahoga Heights, Ohio.** Bryant, C.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1978. 6p. NTIS, PC A02/MF A01.

An investigation regarding possible hazardous exposure to Samoclene in the die shop of a wire mill has been made. A die shop, located within the wire mill, produces the various kinds of dies used in the production of steel wire. Various types of abrasives and lubricants are used in making the dies. A rinsing solution, Samoclene No. 128-M, is used to remove the abrasives and lubricants from the dies. Breathing zone and general area samples were taken for mineral spirits and benzene. Results of the environmental sampling indicate that employees were not exposed to airborne contaminants at toxic concentrations during the investigation.

14434 (PB—291670) **Health hazard evaluation determination report 77-97-482, Inland Steel Company, Indiana Harbor Works, East Chicago, Indiana.** Evans, W.A.; Stroman, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1978. 20p. NTIS, PC A02/MF A01.

An investigation regarding employee exposure to inorganic lead during the production of leaded steel for precision products of good machinability has been conducted. The area of concern was in the pouring stand of the 'Pit' section of the Basic Oxygen furnace shop. Atmospheric samples for lead were collected on Millipore filters Type AA* (mixed cellulose ester) with 0.8 micron pore size. Personal samples were taken at the employee's breathing zone using a battery powered vacuum pump. Area samples were collected with the same equipment along the pouring stand. The medical evaluation included interviews, physical examinations, and blood chemical analysis. It has been determined that a potential hazard to the health of the workers exposed to lead dust and fumes exists. Ten of thirteen personal samples for inorganic lead exceeded the proposed 100 micrograms of lead per cubic meter of air microgram/cu m. Eight personal samples exceeded the current lead standard of 200 microgram/cu m. These concentrations ranged from 25-2600 microgram/cu m of lead. Of the 16 blood lead analyses, three were in excess of 60 micrograms of lead per 100 milliliters of whole blood (60 microgram/100 ml), five were in the range of 40-60 microgram/100 ml, and eight were less than 40 microgram/100 ml.

14435 (PB—291671) **Health hazard evaluation determination report 77-124-479, Interlake Steel, Inc., Newport, Kentucky.** Gilles, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1978. 9p. NTIS, PC A02/MF A01.

An evaluation of employee exposure to soluble oil during steel pipe manufacture has been made. Throughout the building during the time of this investigation, drums of coal, coke or wood materials were being burned to provide heat in the building. Several workers reported that the fires were being started or periodically renewed using the coating oil. Personal breathing zone samples for oil mist were collected. Nondirected medical questionnaires were administered to 12 randomly selected individuals to determine if they were experiencing any health problems which they felt were work related. It has been determined on the basis of environmental sampling the levels of oil, mist, welding fumes, mineral spirits, toluene and xylene did not exceed recommended criteria on an 8 hour time-weighter average concentration basis. However, results of employee interviews indicated workers are experiencing eye and upper respiratory irritation which they related to the open burning fires used to provide heat. Based on these complaints and on good housekeeping and safety practices, the open fires should be replaced with an appropriate alternative source of heat.

14436 (PB—291672) **Health hazard evaluation determination report 77-119-481, Houston chemical Company, Beaumont, Texas.** White, G.L.; Lybarger, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1978. 23p. NTIS, PC A02/MF A01.

An evaluation of hazardous effects associated with ethylene dibromide (EDB), with particular attention to effects on the reproduction system has been conducted. General area and personal samples for EDB and other airborne organic vapor contaminants were obtained. The medical history and physical examinations were conducted. The history included an occupational history, and a medical history with questions on fertility, sexual dysfunction, and diseases which might cause sterility. Laboratory tests included serum luteinizing hormone (LH), follicle stimulating hormone (FSH), testosterone, brominated hydrocarbons, and for those who volunteered, a semen density. It has been determined, based on environmental and medical evidence, that a hazard to the health of workers exposed to EDB did not exist. The medical evaluation did, however, reveal some abnormalities in the results obtained that remain unexplainable and merits continued care in the use of EDB. Environmental sampling indicated that the employees were not exposed to detectable levels of EDB based on 25 personal breathing zone samples.

14437 (PB—291674) **Walk-through survey report FMC Corporation film packaging division, Fredericksburg, Virginia 22401. Final report.** Zaebst, D.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1978. 7p. NTIS, PC A02/MF A01.

An industrial hygiene survey to evaluate the FMC Corporation Film and Packaging Division, Fredericksburg, Virginia, plant for use in the industrial hygiene phase of an industry-wide study of mortality and reproductive health effects of carbon disulfide (75150) has been conducted. The major product of this facility is cellophane and the plant has a present rated capacity of 100 million pounds per year. Another byproduct, sodium sulfate (7757826) is also recovered and marketed. The facility maintains its own medical and industrial hygiene programs. The company also has a formal safety program. Environmental monitoring of CS has been conducted by plant personnel since the beginning of operations. It is concluded that the site cannot be recommended for reproductive, mortality or cross-sectional medical studies due to lack of a suitable control population. The plant at present makes only cellophane and does not have a comparable work force of employees in similar jobs not exposed to CS2; however, given the size and variation of its workforce, the site is considered suitable for inclusion in an industrial hygiene study.

14438 (PB—291675) **Survey for n-nitroso compounds at White and Bagley Company, Worchester Center Blvd., Worchester, Massachusetts. Final report.** Wolf, M.; Young, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1977. 9p. NTIS, PC A02/MF A01.

A hazard evaluation and technical assistance survey of White and Bagley Company, Worchester, Massachusetts, to determine the extent of exposure to N-nitroso compounds of employees involved in the manufacture of cutting fluids and lubricants is reported. Bulk air samples were taken from separate areas in the manufacturing process. N-nitrosodiethanolamine (55185) (NDEIA) was detected in concentrations from 20 to 500ppm in all samples except one. An unidentified nonpolar triethanolamine (121448) (TEA) responding material was also observed. The presence of NDEIA represents a potential hazard through dermal contact or inhalation. The occurrence of NEDIA in the sampled TEA storage tank was considered an obvious source of contamination. However, a sample of grinding concentrate contained 7 times as much NDEIA as would come from the TEA used alone, and the packaged product contained almost 90 times the level of NDEIA expected if TEA were the only source of contamination.

14439 (PB—291679) **Walk-through survey report Monsanto Company Fibers Division, Decatur, Alabama 35601. Final report.** Brown, J.; Robinson, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 7 Feb 1978. 10p. NTIS, PC A02/MF A01.

An industrial hygiene survey to assess personnel records and possible exposures of persons involved in the use of acrylonitrile (AN) (107131) at the Monsanto Company Fibers Division, Decatur, Alabama, is reported. The plant is involved in the manufacture of acrylic fibers, polyester staple, nylon tire yarn, nylon staple, nylon intermediate chemicals, polyester flake, polystyrene plastics, and ChemCoke. The nylon intermediates manufactured are adiponitirile (ADN) (111693) and hexamethylenediamine (HMD) (124094). Personnel exposure sampling is done routinely under the direction of the plant industrial hygienist. Personnel exposure measurements taken during 1977 were below 5ppm with one exposure at 10ppm. Cases of people exposed to AN exhibiting medical symptoms have been noted by this plant. In addition, extensive medical records have been maintained on current, terminated, and retired employees. It is suggested that this plant is suitable for epidemiological studies because: (1) exposure to AN is distinct; (2) the plant has been in operation a considerable time; (3) the population is large; and (4) the record-keeping system is good.

14440 (PB—291680) **Walk-through survey report Monsanto Plastics and Resins Co., Addyston, Ohio 45001. Final report.** Jones, J.; Brown, J.; Robinson, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 22 Feb 1978. 5p. NTIS, PC A02/MF A01.

An industrial hygiene survey to assess personnel records and possible exposures to acrylonitrile (AN) (107131) in the Monsanto Plastics and Resins Company, Addyston, Ohio, for potential use in a retrospective cohort mortality/industrial hygiene survey is reported. The plant is involved in the production of AN polymers. Levels of exposure to AN vary with the process used. It is postulate that before 1974 levels of exposure to AN may have been greater than 100ppm during periods of peak exposure. Personal air samples taken by the company during 1977 are all below 20ppm with most below 10ppm. The company has an extensive medical program including health maintenance, and individually designed annual physical examinations. Tests considered relevant to occupational exposure are conducted on a regular basis. It is maintained that the personnel records contain suitable data for use in a mortality study.

14441 (PB—291682) **Walk-through survey report American Cyanamid Co., Fibers Division, Santa Rosa Plant, Milton, Florida.**

Final report. Brown, J.; Robinson, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1978. 8p. NTIS, PC A02/MF A01.

An industrial hygiene survey to assess personnel records and possible exposures to acrylonitrile (AN) (107131) in the American Cyanamid Co., Fibers Division, Santa Rosa Plant, Milton, Florida, as guides to their usefulness in a retrospective, cohort mortality/industrial hygiene study is reported. The facility is involved in the manufacture of acrylic and modacrylic fibers. Area sampling has been operated by plant personnel since 1974. A regular personal sampling program began in January, 1977. Exposures to AN in the laboratory average 0.7ppm; those in the plant average 1.6ppm (arithmetic average). Medical examinations have been available optionally to employees but are now mandatory. Medical and personnel files have been maintained on current and terminated employees. It is concluded that the major limitations in the use of the facility for epidemiological studies are its age and size; however, the unconfounded exposure to AN experienced by this population is uncommon, and makes the plant suitable for an industrial hygiene study, if other limitations can be overcome.

14442 (SAND—80-0068) **Special Projects Division quarterly report of Progress, 1 October-31 December 1979.** (Sandia Labs., Albuquerque, NM (USA)). Jan 1980. Contract EY-76-C-04-0789. 20p. Dep. NTIS, PC A02/MF A01.

Audit/Appraisal Guidelines for Organizational ES and H Assurance Programs, SAND79-1812, was published this quarter. The quidelines presented in this document are designed to provide a means for efficient evaluation of Environment, Safety, and Health (ES and H) assurance programs that are conducted on the basis of An Environment, Safety, and Health Assurance Program Standard, SAND79-1536, published last quarter. Preliminary versions of model ES and H plans for institutions and line organizations were completed. A comprehensive briefing on the efforts of the Special Projects Division over the last 2 years to develop and test an ES and H Assurance Program was prepared. The briefing given to representatives of 12 of the nation's largest corporations has resulted in uniformly positive feedback. Efforts to compare the characteristics of ES and H programs based on SAND79-1536, An Environment, Safety, and Health Assurance Program Standard, with program characteristics implied in recommendations by the President's Commission on the Accident at Three Mile Island have begun. Initial results appear to indicate that use of the program standard at the operating level would lead to a program that addresses all of the commission's general recommendations dealing with industry. In addition, such use would appear to be consistent with the commission's charge that the regulatory agency's primary statutory mission and first operating priority must be the assurance of safety and lead to a regulatory program consistent with recommendations supporting this mandate.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 13168, 13175, 14243, 14450

14443 (LA-UR—80-224) **Thermomechanical models of the Rio Grande rift.** Bridwell, R.J.; Anderson, C.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 35p. (CONF-7904122—1). Dep. NTIS, PC A03/MF A01.

From Conference on the mechanisms of continental drift and plate tectonics; Newcastle-upon-Tyne, UK (Apr 1979).

Fully two-dimensional, coupled thermochemical solutions of a continental rift and platform are used to model the crust and mantle structure of a hot, buoyant mantle diapir beneath the Rio Grande rift. The thermomechanical model includes both linear and nonlinear laws of the Weertman type relating shear stress and creep strain rate, viscosity which depends on temperature and pressure, and activation energy, temperature-dependent thermal conductivity, temperature-dependent coefficient of thermal expansion, the Boussinesq approximation for thermal bouyancy, material convection using a stress rate that is invariant to rigid rotations, an elastically deformable crust, and a free surface. The model determines the free surface velocities, solid state flow field in the mantle, and viscosity structure of lithosphere and asthenosphere. Regional topography and crustal heat flow are simulated. A suite of symmetric models, assumes continental geotherms on the right and the successively increasing rift geotherms on the left. These models predict an asthenospheric flow field which transfers cold material laterally toward the rift at $>$ 300 km, hot, buoyant material $\sim$ 200 km wide which ascends vertically at rates of 1 km/my between 175 to 325 km, and spreads laterally away from the rift at the base of the lithosphere. Crustal spreading rates are similar to uplift rates. The lithosphere acts as stiff, elastic cap, damping upward motion through decreased velocities of 1 km/10 my and spreading uplift laterally. A parameter study varying material coefficients for the Weertman flow law suggests asthenospheric viscosities of $\sim 10^{22}$ to 10^{23} poise. Similar studies predict crustal viscosities of $\sim 10^{25}$ poise. The buoyant process of mantle flow narrows and concentrates heat transport beneath the rift, increases upward velocity, and broadly arches the lithosphere. 10 figures, 1 table.

14444 (ONWI—21) **Geothermal alteration of clay minerals and shales: diagenesis.** Weaver, C.E. (Georgia Inst. of Tech., Atlanta (USA)). Jul 1979. Contract EY-76-C-06-1830. 192p. Dep. NTIS, PC A09/MF A01.

The objective of this report is to perform a critical review of the data on the mineral and chemical alterations that occur during diagenesis and low-grade metamorphism of shale and other clay-rich rocks - conditions similar to those expected from emplacement of heat-producing radioactive waste in a geologic repository. The conclusions drawn in this document are that the following type of alterations could occur: smectite alteration, ion mobilization, illitic shales, kaolinite reactions, chlorite reactions, organic reactions, paleotemperatures, low temperature shales, high temperature shales, and phase equilibrium changes.

14445 (UCRL—52884) **Summary of measured medium properties of Paleozoic rocks at the DOE Nevada Test Site.** McKague, H.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 2 Jan 1980. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

Selected measurements of the bulk density, grain density, sonic velocity, water content, porosity, and saturation of Paleozoic rocks beneath Yucca Flat are compiled. The bulk density and sonic velocity data show these measurements to be within the range established by similar measurements in other areas. Comparisons with values used in TENSOR calculations suggest that the values used in most calculations are sufficiently conservative for containment evaluation. 2 figures, 3 tables.

GEOPHYSICS

14446 (LA—8086-MAP) **Bouguer gravity map of North-central New Mexico.** Williams, L.M. (Los Alamos Scientific Lab., NM (USA)). Oct 1979. Contract W-7405-ENG-36. 32p. Dep. NTIS, PC A03/MF A01.

Two maps are provided, the actual gravity map and one of station locations. (RWR)

SEISMOLOGY AND TECTONICS

14447 (N—79-17404) **Seismic events in the USA in 1972.** Israelson, H.; Basham, P.; Elvers, E.; Slunga, R.; Dahlman, O. (National Defense Univ., Washington, DC (USA). Research Directorate). Jun 1978. 84p. NTIS, PC A05/MF A01.

In all 268 events were defined, 260 of which were reported by the National Oceanic and Atmospheric Administration in USA. The other 8 events, all located near the Nevada Test Site (NTS), were obtained using data acquired at Canadian, North European, and USA seismological stations. A hypocenter estimation model was developed for precise location of events close to borders and shorelines. The set of defined events is believed to be almost complete down to a body wave magnitude, m /sub b/, around 4. Criteria based on reordings of the Canadian Seismograph Network, the Hagfors Observatory in Sweden, and two VLPE stations in the USA were used for identification of the events. An identification model using m/sub b/ (M /sub s/)-data at several stations was developed for the particular type of m/sub b/ (M /sub s)-data of the study. The model was designed to ultize upper bound estimates of M /sub s/. A screening procedure for event identification was designed from observations of explosions and earthquakes independent of the 1972 data.

14448 (UCRL—52867) **Elastic-wave radiation from spherical sources.** Rodean, H.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Dec 1979. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

The radiation of spherical compressional waves from a spherical cavity in an ideal elastic solid is treated. The equations for the radiation source and field are written in terms of the reduced-displacement potential. The source equation is studied in terms of characteristic frequencies, corresponding periods and wavelengths, and damping. The field equations for the stresses, strains, radial displacement, etc., are reviewed with regard to the transitions between the near and far fields. The natural parameters for defining the dynamic source and field characteristics are 2b/R and b/a in some cases and a/R in others, where a is the compressional-wave velocity, b the shear-wave velocity, and R the cavity radius. Transient solutions for stresses, strains, radial displacement, etc., include damped

sinusoidal oscillations. The initial- and final-value theorems for the Laplace transform are used to obtain solutions for tau (reduced time) → 0 + (high-frequency, farfield) and tau → ∞ (zero-frequency, near-field). 14 figures, 4 tables.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 13172, 13173, 14445

14449 (UCRL—15149) **Hydrologic properties of shale and related argillaceous rocks.** Moiseyev, A.N. (California State Univ., Hayward (USA). Dept. of Geological Sciences). 15 Nov 1979. Contract W-7405-ENG-48. 175p. Dep. NTIS, PC A08/MF A01.

This report is the result of a bibliographic study designed primarily to collect hydrologic data on American clay-rich rocks. The following information was also sought: stratigraphy, environment of deposition, mineralogic composition, and diagenetic changes. The collected numerical data are presented in tables which contain densities, porosities, and/or hydraulic conductivities of approximately 360 samples. Additional data include hydraulic diffusivities, resistivities, flow rates, and rock strengths. Geologic information suggests that large deposits of shale which may be suited for waste repository belong to all ages and were formed in both marine and continental environments. Of the studied units, the most promising are Paleozoic in the eastern half of the country, Mesozoic in the central part, and Cenozoic in the Gulf Coast area and the West. Less widespread units locally present some additional possibilities. Mineralogic investigations suggest that the smectite content in rocks shows a decrease in time (70% in Recent rocks; 35% in pre-Mesozoic rocks). Because of this predominance of smectite in younger rocks, the modeling of repositories in post-Paleozoic formations might require knowledge of additional and poorly known parameters. Results of investigations into the mathematical relationships between porosity and permeability (or hydralic conductivity) suggest that in situ permeabilities could be estimated from sonic logs and fluid pressure changes at depth. 16 figures, 8 tables.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 13120

OCEANOGRAPHY

14450 (LBL-publ—253) **Oceanographic data off Oregon 43° to 46° North including the Astoria Deep Sea Fan.** Wilde, P.; Chase, T.E.; Holmes, M.L.; Normark, W.R.; Thomas, J.A.; McCulloch, D.S.; Carlson, P.R.; Kulm, L.D.; Young, J.D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1979. Contract W-7405-ENG-48. vp. Univ. of California, Berkeley.

This data compilation provides a chart of convenient size that summarizes oceanographic data and can be used during geological and oceanographic investigations. The following information is included: ocean depths, geographic features, earthquake epicenters, bottom sediments and heat flow, magnetic lineations, free-air gravity anomaly, seismic reflection profiles, crustal and subcrustal cross sections, gravity profile, stratigraphy and lithology of drilling sites, and sea currents and surface temperatures. 11 figures. (RWR)

PHYSICS RESEARCH

14451 (LA—7585-PR) **Theoretical Division progress report.** Cooper, N.G. (comp.). (Los Alamos Scientific Lab., NM (USA)). Apr 1979. Contract W-7405-ENG-36. 304p. Dep. NTIS, PC A14/MF A01.

This report presents highlights of activities in the Theoretical (T) Division from October 1976-January 1979. The report is divided into three parts. Part I presents an overview of the Division: its unique function at the Los Alamos Scientific Laboratory (LASL) and within the scientific community as a whole; the organization of personnel; the main areas of research; and a survey of recent T-Division initiatives. This overview is followed by a survey of the 13 groups within the Division, their main responsibilities, interests, and expertise, consulting activities, and recent scientific accomplisments. The remainder of the report, Parts II and III, is devoted to articles on selected research activities. Recent efforts on topics of immediate interest to energy and weapons programs at LASL and elsewhere are described in Part II, Major National Programs. Separate articles present T-Divison contributions to weapons research, reactor safety and reactor physics research, fusion research, laser isotope separation, and other energy research. Each article is a compilation of independent projects within T Division, all related to but addressing different aspects of the major program. Part III is organized by subject discipline, and describes recent scientific advances of fundamental interest. An introduction, defining the scope and general nature of T-Division efforts within a given discipline, is followed by articles on the research topics selected. The reporting is done by the scientists involved in the research, and an attempt is made to communicate to a general audience. Some data are given incidentally; more technical presentations of the research accomplished may be found among the 47 pages of references. 110 figures, 5 tables.

ASTROPHYSICS AND COSMOLOGY

STARS

REFER ALSO TO CITATION(S) 14125

SOLAR PHENOMENA

14452 (LA-UR—80-22) **Pre-main sequence sun: a dynamic approach.** Newman, M.J.; Winkler, K.H.A. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 18p. (CONF-7910123—1). Dep. NTIS, PC A02/MF A01.

From Lunar and Planetary Institute topical conference on the ancient sun; Boulder, CO, USA (Oct 1979).

The classical pre-main sequence evolutionary behavior found by Hayashi and his coworkers for the Sun depends crucially on the choice of initial conditions. The Hayashi picture results from beginning the calculation with an already centrally condensed, highly Jeans unstable object not terribly far removed from the stellar state initially. The present calculation follows the work of Larson in investigating the hydrodynamic collapse and self-gravitational accretion of an initially uniform, just Jeans unstable interstellar gas-dust cloud. The resulting picture for the early history of the Sun is quite different from that found by Hayashi. A rather small (R ~ = 2 R/sub sun/), low-luminosity (L ≧ L/sub sun/) protostellar core develops. A fully convective stellar core, characteristic of Hayashi's work, is not found during the accretion process, and can only develop, if at all, in the subsequent pre-main sequence Kelvin-Helmholtz contraction of the core. 3 figures, 1 table.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 14476

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 13930

14453 (LBL—8413) **Image processing of small protein-crystals in electron microscopy.** Feinberg, D.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1978. Contract W-7405-ENG-48. 71p. Dep. NTIS, PC A05/MF A01.

This electron microscope study was undertaken to determine whether high resolution reconstructed images could be obtained from statistically noisy micrographs by the super-position of several small areas of images of well-ordered crystals of biological macromolecules. Methods of rotational and translational alignment which use Fourier space data were demonstrated to be superior to methods which use Real space image data. After alignment, the addition of the diffraction patterns of four small areas did not produce higher resolution because of unexpected image distortion effects. A method was developed to determine the location of the distortion origin and the coefficients of spiral distortion and pincushion/barrel distortion in order to make future correction of distortions in electron microscope images of large area crystals.

ATOMIC AND MOLECULAR PROPERTIES

14454 (ANL—79-40, pp 183-184) **Photoionization mass spectrometry of UF_6.** Berkowitz, J. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The photoionization mass spectrum of $^{238}UF_6$ was obtained. At 600 A = 20.66 eV, the relative ionic abundances were as follows: UF_6^+, 1.4; UF_5^+, 100; UF^+, 17; UF_3^+, ~ 0.7; UF_2^+, very weak; UF^+, very weak; U^+, essentially zero. The adiabatic ionization potential for UF_6 was 13.897 +- 0.005 eV. The production of UF_5^+ begins at ~ 887 A = 13.98 eV, at which energy the UF_6^+ partial cross section abruptly declines and then levels off. This behavior suggests the vague possibility of an isotope effect. The UF_4^+ signal begins at ~

725 A = 17.10 eV, at which energy the UF_5^+ signal reaches a plateau value. The UF_5^+ photoionization yield curve displays some autoionization structure from its threshold to ~ 750 A. (RWR)

14455 (COO—4264-9) **Theoretical energy levels of $^3F^o$ Rydberg series for Mg I, Al II, and Si III.** Fischer, C.F. (Pennsylvania State Univ., University Park (USA). Dept. of Computer Science). 1979. Contract EG-77-S-02-4264. 31p. (CONF-7906128—2). Dep. NTIS, PC A03/MF A01.

From 46. Nobel symposium on many-body theory of atomic systems; Aspenasgarden, Lerum, Sweden (11 Jun 1979).

A muiticonfiguration Hartree-Fock procedure for excited states is described and applied to states of the Rydberg series up to 3s 8f $^3F^o$ in Mg I, Al II, and Si III. Energies relative to the ionization limit agree with observation to within 1%, an exception being the case of near-degeneracy in Al II, where a discrepancy of 2.5% occurs. Systematic errors are observed. Some possible sources of errors are considered. 2 figures, 6 tables.

14456 (COO—4264-10) **Effect of correlation in the 3d/sup n/ core on the resonance transition in Cu II.** Fischer, C.F.; Glass, R. (Pennsylvania State Univ., University Park (USA)). 1979. Contract EG-77-S-02-4264. 6p. (CONF-7906128—3). Dep. NTIS, PC A02/MF A01.

From 46. Nobel symposium on many-body theory of atomic systems; Aspenasgarden, Lerum, Sweden (11 Jun 1979).

A preliminary report is presented on the effect of correlation in the 3d/sup n/ core on the $3d^{10}\ ^1S \rightarrow 3d^9\ 4p\ ^1P$ f value by use of the multiconfiguration (MC) Hartree-Fock procedure. A common orbital basis was used for correlation in the core, with virtual orbitals determined variationally for the initial state. Three different approximations were used: a single-configuration approximation for both initial and final state, a MC approximation for $3d^{10}$ correlation in the initial state and a single configuration for the final state, and MC approximations for both initial and final states. Some preliminary f values for the $3d^{10}\ ^1S \rightarrow 3d^9\ 4p\ ^1P$ transition are tabulated. Comparison of calculated with experimental values indicates that correlation in the $3d^9$ core of the final state is needed to obtain the correct transition energy to bring the length and velocity forms into good agreement with themselves and experiment, and that the multiplet strength for the transition is not greatly affected by correlation. 1 table. (RWR)

14457 (COO—4264-12) **Some MCHF results for Rydberg States.** Fischer, C.F.; Hansen, J.E. (Pennsylvania State Univ., University Park (USA). Dept. of Computer Science; Amsterdam Univ. (Netherlands). Zeeman Lab.). 1979. Contract EG-77-S-02-4264. 2p. (CONF-790997—2). Dep. NTIS, PC A02/MF A01.

From SAS-79 symposium on atomic spectroscopy; Tuscon, AZ, USA (10 Sep 1979).

The multiconfiguration Hartree-Fock method (MCHF) was applied to a study of the 3s nd, n = 4 to 8, states in the $^3F^o$ series of Al II with the well-known 3p 3d perturber. Procedures were devised to stabilize the calculation in the presence of strong interactions with a perturber and facilitate the calculation for a series. Basis states of the type 3s nf, pd, df, and pg were included. Excellent agreement was achieved with the statistically weighted observed energy relative to the ionization limit, except in the vicinity of the perturber. These calculations are compared with MQDT results of other authors. (RWR)

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 14517

ATOMIC AND MOLECULAR THEORY

14458 (LA—8062) **Theoretical equations of state for the rare gases.** Kerley, G.I.; Henry, P.M. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 41p. Dep. NTIS, PC A03/MF A01.

Theoretical equations of state and related calculations are reported for the rare gases neon, argon, krypton, and xenon. The liquid and vapor phases were computed using a model which is based upon thermodynamic perturbation theory. The fluid model requires an expression for the potential energy of a molecule in the force field of its neighbors; this function is derived from the zero-temperature isotherm of the solid. The solid isotherm was determined from static-compression data and statistical atom theory. The solid data were the only experimental information used to construct the liquid model. Comparisons are made with measured isothermal-compression data, sound speeds, vaporization curves, Hugoniots, structure factors, viscosities, and melting curves. Agreement with experiment is good.

GENERAL FLUID DYNAMICS

REFER ALSO TO CITATION(S) 14525

14459 (CONF-790902—, pp 138-143) **Steady high Reynolds number flow past a cylinder.** Fornberg, B. (California Inst. of Tech., Pasadena). 1979.

From Impact of advanced systems on scientific computations; Livermore, CA, USA (12 Sep 1979).

Viscous flow past a circular cylinder becomes unstable around Reynolds number Re = 40. With a new numerical technique, based on Newton's method, steady (but unstable) solutions of high accuracy were obtained up to Re = 300. A new trend in the solution was found when the Reynolds number was increased above 260. The wake bubble begins to decrease in length as vorticity in the wake is convected back towards the body. The numerical calculations were performed on the CDC STAR-100 computer at the CDC Service Center in Minneapolis. 14 figures.

14460 (UCRL—83609) **Brightness temperature measurements for high-energy jet propagation.** Glenn, H.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jan 1980. Contract W-7405-ENG-48. 13p. (CONF-800307—2). Dep. NTIS, PC A02/MF A01.

From Fiber optic in the nuclear environment symposium; Adelphi, MD, USA (25 Mar 1980).

This paper describes the use of fiber optics to measure times of arrival and brightness temperature profiles for high-energy gas jets. Voitenko compressors have been used to produce high-energy air and oxygen jets through steel pipes 2 cm in i.d. and 350 cm in length containing air initially at 0.02 Torr or less. Reduction of the time-of-arrival data indicated that velocities for the various identified jet components ranged between 2.40 and 7.95 cm/μsec. The fiber optics emplacement design and brightness temperature calibration procedure are described. Maximum brightness temperatures of 93,000 and 136,000°K have been measured for air and oxygen jets, respectively, as they started down the exit pipes. Brightness temperature profiles have been obtained to 50 μsec behind the jet front. The results suggest that delayed entrainment of wall material was the predominant factor in reducing pressures and temperatures in the slower components of the jet.

MAGNETOHYDRODYNAMICS

14461 (AD-A—062743) **A numerical scheme for predicting transient shock, boundary layer, and magnetohydrodynamic phenomena. Final report, September 1974-June 1978.** Feldman, L.A. (Arnold Engineering Development Center, Arnold Air Force Station, TN (USA)). Dec 1978. 373p. Availability: Microfiche copies only.

A stable procedure of first order accuracy for solving the coupled axisymmetric transient gasdynamic and electromagentic equations is presented. A numerical integration technique developed by Matuska for inviscid flow is extended to include viscous and electromagnetic terms with stability, convergence and computational speed comparing favorably with other existing hydrocodes. In this investigation, the method is applied to a number of transient hydrodynamic and magnetohydrodynamic applications characterized by the interaction of gasdynamic, electromagnetic and viscous flow phenomena. The external flow field around an M-117 warhead, an ablating reentry vehicle and a semi-infinite circular cylinder, and the internal flow of a nozzle, shock tube and MHD channel is examined under viscous and inviscid conditions. Attention is focused on the behavior of a conducting fluid in the presence of shocks, boundary layers, heat transfer and electromagnetic fields. Finally, the investigation of an MHD generator is described with emphasis placed on aerodynamic and viscous effects influencing the behavior of the energy conversion process. Results of these calculations are shown to be in close agreement with experiment and other theoretical solutions.

HIGH ENERGY PHYSICS

14462 (DOE/ER/05096—T1) **High energy physics. Progress report, April 1, 1979-February 29, 1980.** Phillips, G.C.; Roberts, J.B. (Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.). 1980. Contract AS05-76ER05096. 27p. Dep. NTIS, PC A03/MF A01.

Research is reported in these experiments: polarization in large angle n-p elastic scattering at 2, 3, and 6 GeV/c; depolarization in $pp \rightarrow pN^*$ at 6 GeV/c; A/sub nn/ in n-p elastic scattering at 6 GeV/c; A/sub nn/,A, and $\Delta\sigma$/sub γ/ in p-p scattering from 1-12 GeV/c; $\Delta\sigma$/sub tau/ in p-n scattering from 1-2.5 GeV/c; and spin asymmetries in $pp \rightarrow p\pi^+$ from 1-2 GeV/c. Three new experiments are described: asymmetries in inclusive pion production with a polarized beam and target; measurement of $\Delta\sigma$/sub tau/ in p-d and

p-p scattering from 1-2.5 GeV/c; and polarization asymmetries in pp-pπ^+n from 1.2-2.0 GeV/c. (GHT)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

ELECTROMAGNETIC INTERACTIONS

14463 (COO—1545-269) **Polarization asymmetries in e^+e^- inclusive hadron production.** Schmidt, I.A.; Wada, W.W. (Stanford Univ., CA (USA); American Univ., Washington, DC; Ohio State Univ., Columbus (USA). Dept. of Physics). Nov 1979. Contract EY-76-C-03-0515;EY-76-C-02-1545. 11p. Dep. NTIS, PC A02/MF A01.

Interference effects between electromagnetic and weak interactions in e^+e^- hadronic production, which are free from higher order QED corrections, are considered. In particular the asymmetry between the cross sections is calculated when one of the beams is longitudinally polarized positvely and negatively, the other unpolarized. This asymmetry is then parity non-conserving. Numerical results are given for total hadronic cross sections, and for π, K^{-+}, D^{-+} inclusive production.

14464 (LBL—10389) **Gamma and pizero production in e^+e^- annihilation.** Fong, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1980. Contract W-7405-ENG-48. 129p. Dep. NTIS, PC A07/MF A01.

Thesis.

Inclusive cross sections of γ's and π^0 mesons in hadronic events produced by electron-positron annihilation for the center-of-mass energy range 4.9 to 7.4 GeV are presented. Scale invariance of the inclusive spectra is exhibited in this energy range, and their normalization and shape are seen to be consistent with those of spectra arising from the decay of the π^0. The fraction of center-of-mass energy carried away by the γ's at high energies is found to be $< E/sub\ \gamma//E/sub\ c.m./> = 0.24 +- 0.01$. The π^0 inclusive cross section is seen to be consistent in normalization and shape with half the charged-π cross section between x = 0.15 and 0.75, with an integrated inclusive cross-section ratio of $\sigma(\pi^0)/[\sigma(\pi^+) + \sigma(\pi^-)] = 0.48 +- 0.05$. 60 figures, 7 tables.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 14463

14465 (LA—7966) **Extraction of the Michel parameters from muon decay by a maximum likelihood method.** McKee, R.J. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

A maximum likelihood method was developed for extracting the Michel parameters, which describe the decay spectrum of stopped polarized muons. The method was applied successfully in a Monte Carlo simulation of apparatus. A complete error matrix for the set of Michel parameters was also obtained. In an experiment of 10^8 muon decays the statistical errors can be reduced by more than an order of magnitude over the currently accepted limits on the Michel parameters. 5 tables.

STRONG BARYON-INDUCED INTERACTIONS

14466 (BNL—27154) **Hypernuclear physics research at Brookhaven.** May, M. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 15p. (CONF-7909118—1). Dep. NTIS, PC A02/MF A01.

From International conference on hypernuclear and low energy kaon physics; Jablonna, Poland (11 Sep 1979).

This paper describes the results of a recently completed study of the hypernucleus ^{12}/sub Λ/C. The observed formation of hypernuclear states at large momentum is compared with theoretical expectations. Future directions of the research program at Brookhaven are outlined.

14467 (DOE/ER/01316—, pp 14-15) **Production of the Δ^{++} in the reaction pp $\rightarrow$ π^+n at 800 MeV.** Hudomalj-Gabitzsch, J.; Mutchler, G.S. 1980.

In Nuclear structure at intermediate energies. Progress report, April 1, 1979-March 31, 1980.

Differential cross sections for the angle pairs 20° to 22° and 19° to 22° are plotted against momentum from 400 to 1000 MeV/c. 1 figure. (RWR)

14468 (DOE/ER/01316—, pp 16) **Δi production in the pp $\rightarrow$ ppπ^0 reaction at 800 MeV.** Pepin, G.P.; Mutchler, G.S.; Furic, M. 1980.

In Nuclear structure at intermediate energies. Progress report, April 1, 1979-March 31, 1980.

Differential cross sections for several angle pairs are plotted as a function of the momentum of the spectrometer-analyzed proton. The data were analyzed by use of the π and rho exchange model with various baryonic intermediate states. The model was found inadequate to reproduce the date over all phase space. 5 figures, 1 table. (RWR)

14469 (DOE/ER/01316—, pp 16-29) **Studies of the spin dependence of p up arrow p $\rightarrow$ pπX.** Mutchler, G.S.; Pinsky, L.S. 1980.

In Nuclear structure at intermediate energies. Progress report, April 1, 1979-March 31, 1980.

The beam-spin asymmetry in the reaction pp $\rightarrow$ pπ^+n was measured in a kinematically complete experiment at 800 MeV. 4 figures, 1 table. (RWR)

STRONG MESON-INDUCED INTERACTIONS

14470 (COO—1195-446) **Observation of quasi two-body production in pion plus proton goes to neutron plus four charged pions at 8 GeV/c.** Wroblicka, W.T. (Illinois Univ., Urbana (USA)). 1980. Contract EY-76-C-02-1195. 76p. Dep. NTIS, PC A05/MF A01.

The first observation of quasi 2-body production in the backward reaction $\pi^-p \rightarrow n\pi^+\pi^+\pi^-\pi^-$ is reported. Data were obtained with an 8-GeV/c pion beam incident on a liquid hydrogen target inside the University of Illinois/Argonne National Laboratory streamer chamber. The chamber was triggered by the interaction of a fast, forward neutral hadron in thick-plate optical spark chambers. Total backward cross sections were derived for the processes $\pi^-p \rightarrow N^{*0}(1520) + rho^0/f^0$, $N^{*0}(1670) + rho^0/f^0$, $\Delta^0(1890) + rho^0/f^0$, and $\Delta^-(1236) + A_2^+$. Evidence for a narrow A_1^+ resonance was not seen. Corrections for losses due to finite acceptance were made by Monte Carlo techniques based on a simple baryon exchange model. Comparison is made to another experiment regarding the energy dependence of certain cross sections, and a simple power law behavior is observed. 16 figures, 8 tables.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

STRONG INTERACTIONS, GENERAL

14471 (DOE/ER/05223—22) **Intermediate-energy nuclear theory. Progress report, July 1, 1979-February 29, 1980.** Bryan, R.A.; VerWest, B.J.; Dominguez, C.A. (Texas A and M Univ., College Station (USA). Dept. of Physics). Nov 1979. Contract AS05-76ER05223. 11p. Dep. NTIS, PC A02/MF A01.

Research during July 1, 1979 to February 29, 1980 was concentrated on improving the phase-shift analyses of NN scattering and studying strong interaction dynamics related to the NN interaction. The techniques for handling high partial waves and inelasticities in NN analyses were examined, along with a better representation of the reaction cross section data. Work continued on the partial-wave projection of theoretical pion production amplitudes for use in NN analyses. The task of reviewing the entire NN scattering data base with a careful review of the np data from 600 to 700 MeV was begun, along with initial analyses of that data. The work in strong interaction dynamics involved a determination of quark mass ratios and two independent determinations of the range of the πNN vertex function. Work on a model for the Pseudophysical N anti N $\rightarrow$ $\pi\pi$ amplitudes was completed, and the initial formulation of a dynamical theory for isospin was done.

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 14473

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

14472 (BNL—26961) **Production of double hypernuclei via the (K^-, K^+) reaction.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 29p. (CONF-7909118—2). Dep. NTIS, PC A03/MF A01.

From International conference on hypernuclear and low energy kaon physics; Jablonna, Poland (11 Sep 1979).

Cross section estimates are presented for the formation of $\Lambda\Lambda$ and Ξ hypernuclei in the (K^-, K^+) strangeness exchange reaction, both for transitions to particular low-lying final states and also for the summed cross section. The problem of the well depth and damping width for a Ξ^- in nuclear matter is also addressed.

14473 (BNL—27066) **Updated estimates of W production in pp and anti pp interactions.** Paige, F.E. (Brookhaven National Lab., Upton, NY (USA)). Oct 1979. Contract EY-76-C-02-0016. 53p. (CONF-7910103—3). Dep. NTIS, PC A04/MF A01.

From Workshop on the production of new particles in super high energy collisions; Madison, WI, USA (22 Oct 1979).

Cross section estimates are given for W production in the Weinberg-Salam model with $\sin^2\theta$/sub W/ = 0.23 and six quark

flavors. Modifications of the Drell-Yan model due to QCD are taken into account. 45 references, 15 figures.

14474 (COO—1545-207) **Strong anomaly and eta → 3π decay.** Milton, K.A.; Palmer, W.F.; Pinsky, S.S. (Ohio State Univ., Columbus (USA). Dept. of Physics; California Univ., Los Angeles (USA). Dept. of Physics). 1979. Contract EY-76-C-02-1545. 9p. Dep. NTIS, PC A02/MF A01.

The amplitude for eta → 3π is calculated in terms of the amplitude for eta' → etaππ using the strong anomaly and the partial conservation of the U(1) current. The isospin violation, an m/sub u/ - m/sub d//m/sub u/ + m/sub d/ effect, is large. The eta' decay constant is estimated from psi → eta'γ. The result for eta → 3π is in good agreement with experiment.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

14475 (COO—1545-265(Rev.)) **Mixing angles and CP violation in SU(2)/sub L/ x U(1) gauge model.** Nandi, S.; Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1979. Contract EY-76-C-02-1545. 7p. Dep. NTIS, PC A02/MF A01.

Expressions for the mixing parameters are obtained in terms of mass ratios in the standard Weinberg-Salam model with permutation symmetry S_3 for six quarks. The CP-violating phase, δ, is taken into account, and there are no arbitrary parameters except for the quark masses. In the lowest order, the angles defined by Kobayashi-Maskawa are sin $\theta_1 \sim =$ (m/sub d//m sub d/ + m/sub s/)/sup 1/2, sin $\theta_2 \sim =$ -[(m/sub s//m/sub b/)^2 - (m/sub c//m/sub t/)^2]/sup 1/2/, and sin $\theta_3 =$ (m/sub s//m/sub b/)^2/cos θ_1. The model can be consistent with the observed magnitude of CP violation. The b quarks decay predominantly into c quarks with lifetime of tau/sub b/ $\sim = 10^{-11}$ s.

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

14476 (ANL—79-40) **Physics Division annual review, 1 April 1978-31 March 1979.** (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 292p. Dep. NTIS, PC A13/MF A01.

A broad review is presented of work in the areas of nuclear physics research (the superconducting linac; medium-energy physics; heavy-ion research at the tandem and superconducting linac accelerators - resonant structures in heavy-ion reactions, fusion cross sections, high-angular-momentum-states in nuclei; charged-particle research; accelerator operations and development; neutron and photonuclear physics; theoretical physics - heavy-ion direct reactions, nuclear shell theory and nuclear structure, nuclear matter, intermediate-energy physics, dense nuclear matter and classical calculations of the high-energy collisions of heavy ions; radiative transitions and nuclear resonance reactions experimental atomic and molecular physics research (dissociation and other interactions of energetic molecular ions in solid and gaseous targets, beam-foil research and collision dynamics of heavy ions, photoionization-photon-electron research, spectroscopy of free atoms, Moessbauer effect research, monochromatic x-ray beam project); and applied physics (interaction of energetic particles with solids scanning secondary-ion microprobe). Most of the reports are quite brief (about a page); 24 pages of references are included. 21 items with significant amounts of information are abstracted individually. (RWR)

14477 (DOE/CH/93026—1) **Assessment of the current status of basic nuclear data compilations.** (National Academy of Sciences, Washington, DC (USA)). 1979. Contract EY-76-C-02-2708-026. 9p. Dep. NTIS, PC A02/MF A01.

The Panel on Basic Nuclear Data Compilations met on April 6, 1979, to review the present status of nuclear data compilations. The following topics are addressed in this report: A-chain situation; ENSDF, Nuclear Structure Reference Files, and Recent References; Handbook of the Nuclides; and charged particle nuclear data. The panel made 13 recommendations, probably the most forceful being its recommendation against the use of data from unreferenced journals in ENSDF. 1 table. (RWR)

14478 (DOE/ER/01316—) **Nuclear structure at intermediate energies. Progress report, April 1, 1979-March 31, 1980.** Phillips, G.C.; Mutchler, G.S. (Rice Univ., Houston, TX (USA). Bonner Nuclear Labs.). 1980. Contract AC05-76ER01316. 46p. Dep. NTIS, PC A03/MF A01.

Progress was made during the year on data analysis on ten experimental topics. Theoretical contributions were made to four of these topics. Three publications resulted. During the year an experiment on p up arrow p → pπ$^+$n was initiated, and preliminary analysis shows large polarization asymmetries. Two Ph.D. degrees were awarded to student members of the group. The principal collaborators for this work were the University of Houston Group. Three sections with data were abstracted separately. 10 figures, 5 tables.

14479 **Data evaluation with lognormal distributions.** Schmittroth, F. (Hanford Engineering Development Lab., Richland, WA). *Nucl. Sci. Eng.;* **72**: No. 1, 19-34(Oct 1979).

The formal basis for a data evaluation method is documented. This method was successfully applied to a variety of practical problems, and details important to these problems are included. The method can be crudely described as a means for using lognormal a priori information in the standard least-squares algorithm. Emphasis is on the proper use of uncertainties and correlations, both in the data to be evaluated and in the final evaluation itself. Finally, important details and pitfalls common to least-squares methods are included. 1 figure.

EXPERIMENTAL TECHNIQUES

REFER ALSO TO CITATION(S) 13938, 14504

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 14513, 14514

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

14480 (ANL—79-40, pp 24-25) **Properties of pion single-charge-exchange reactions in nuclei.** Bowles, T.J.; Geesaman, D.F.; Holt, R.J.; Jackson, H.E.; Laszewski, R.M.; Specht, J.R.; Stephenson, E.J.; Segel, R.E.; Redwine, R.P.; Yates-Williams, M.A.; Julien, J. 1979. In Physics Division annual review, 1 April 1978-31 March 1979.

Proton spectra at 45° from 220-MeV π$^+$ on ^{4}He, ^{12}C, ^{62}Ni, and ^{181}Ta are shown. For ^{4}He clear evidence is seen for a two-body absorption mechanism in which the pion deposits its rest mass and kinetic energy on to two nucleons. This mode is weaker for the heavier nuclei, which have spectra of a distinctly different shape. 1 figure. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

REFER ALSO TO CITATION(S) 14514

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 14482

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 14480

14481 (ANL—79-40, pp 43-44) **Systematics of ^{12}C and ^{16}O induced fusion on targets 12 ≦ A ≦ 19.** Kovar, D.G.; Geesaman, D.F.; Henning, W.; Paul, M.; Sanders, S.J.; Schiffer, J.P. 1979. In Physics Division annual review, 1 April 1978-31 March 1979.

In the lower-energy region, the fusion cross sections seem to be dominated by the interaction barrier. While the barrier radii deduced have a smooth dependence on A, this A dependence is different from that of heavier systems. Barrier radii, R/sub B/, and heights, V/sub B/, are plotted versus A_1/sup 1/3/ + A_2/sup 1/3/. At higher energies, the fusion cross sections are found to saturate at magnitudes which differ significantly for systems which differ by only a nucleon or two. These results constitute evidence for nuclear structure effects in the fusion process. 1 figure. (RWR)

14482 (ANL—79-40, pp 125-127) **R-Matrix analysis of the ^{13}C(γ,n$_0$)^{12}C reaction below an excitation of 9.3 MeV.** Holt, R.J.; Jackson, H.E.; Laszewski, R.M.; Monahan, J.E.; Specht, J.R. 1979. In Physics Division annual review, 1 April 1978-31 March 1979.

The configurations of the $3/2^+$ resonances at 7.7 and 8.2 MeV in ^{13}C have been the subject of numerous theoretical calculations. Unfortunately, the E1 ground-state radiative widths for these resonances have not been previously measured. To extract accurate ground-state transition rates for these resonances, an observed high-resolution photoneutron cross section was interpreted in terms of a multilevel R-matrix analysis. The well-known neutron scattering channel is fully considered. The results of this analysis are compared with the data. it appears that the channel capture widths of the 7.7- and 8.2-MeV resonances are large and their influence must be included in any comparison of the radiative widths with theory. 1 figure.

14483 (COO—1428-462) **Experimental test of pion exchange and PCAC in proton-nucleus charge exchange reactions at 144 MeV.** Moake, G.L.; Debevec, P.T.; Gutay, L.J.; Quin, P.A.; Scharenberg, R.P. (Purdue Univ., Lafayette, IN (USA). Dept. of Physics; Indiana Univ., Bloomington (USA). Dept. of Physics; Wisconsin Univ., Madison (USA). Dept. of Physics). 1979. Contract EY-76-C-02-1428. 12p. Dep. NTIS, PC A02/MF A01.

The differential cross sections of the (p,n) reaction on ^6Li, ^{12}C, and ^{14}N to the ground state of the final nuclei were measured at E/sub p/ = 144 and $0 < \theta$/sub LAB/ $< 20^0$. The quantum numbers of these transitions, like those in Gamow-Teller beta decay, have $\Delta J = 1$, $\Delta T = 1$, and $\Delta P = 0$, which is consistent with the one-pion exchange mechanism. Differential cross sections were calculated with the absorption modified one-pion exchange model. The nucleus was treated as an elementary particle, as first suggested by Kim and Primakoff. By use of the Partially Conserved Axial Vector Current Hypothesis (PCAC) the magnitude and momentum dependence of the initial nucleus-pion-final nucleus coupling constant, g/sub $N\pi N'$/ , was obtained from beta decay and inelastic electron scattering, respectively. The calculations, which had no free parameters, were found to agree with the data for ^6Li and ^{12}C, but not for ^{14}N. 3 figures, 1 table.

14484 (COO—2076-5) **Nuclear structure studies with medium energy probes. Annual progress report, December 1978-December 1979.** Seth, K.K.; Nann, H.; Iversen, S.G.; Kaletka, M.O.; Hird, J.; Barlow, D.; Smith, D. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics). 1979. Contract EY-76-S-02-2706. 26p. Dep. NTIS, PC A03/MF A01.

Brief summaries are given of work on pion reactions and scattering, proton reactions (pion production, elastic and inelastic scattering), and electron reactions. Most of this work has been or will be published in the usual channels. Lists of publications, abstracts, seminars, etc., are also given. 5 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 14485

NUCLEAR REACTIONS AND SCATTERING

14485 (ANL—79-40, pp 30-33) **Excitation of high-spin particle-hole states in ^{28}Si.** Geesaman, D.F.; Olmer, C.; Zeidman, B.; Segel, R.E.; Swenson, L.W.; Boudrie, R.L.; Morris, C.L.; Thiessen, H.A. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

Inelastic scattering of 162-MeV π^+ by ^{28}Si was investigated, The 70^0 spectrum is shown. Among the states seen are the predominantly (1f/sub 7/2 x 1d/sub $5/2^{-1})6^-$ T=0 and T=1 states at excitation energies of 11.58 and 14.36 MeV, respectively. The ratio of cross sections $\sigma(T=0)/\sigma(T=1) = 1.5 +- 0.2$, as compared to the value of 4 expected from estimates based upon 3,3 resonance dominance. Other states with angular distributions indicative of large spin transfer, $\geqq 4$, are also observed. 1 figure. (RWR)

14486 (ANL—79-40, pp 36-38) **Resonant effects in the $^{24}Mg(^{16}O,^{12}C)^{28}Si$ reaction at forward angles.** Paul, M.; Sanders, S.J.; Cseh, J.; Geesaman, D.F.; Henning, W.; Kovar, D.G.; Olmer, C.; Schiffer, J.P. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

Excitation functions for the reactions $^{24}Mg(^{16}O,^{12}C)^{28}Si$ and $^{24}Mg(^{16}O,^{16}O)^{24}Mg$ at 23 to 38 MeV (c.m.) are shown. Resonance-like structures are seen. Angular distributions measured at the maximum of the excitation function were fitted rather well with the square of a single Legendre polynomial of order close to that of the grazing partial wave. 1 figure. (RWR)

14487 (ANL—79-40, pp 39-41) **Analysis of the $^{24}Mg(^{16}O,^{12}C)^{28}Si$ reaction.** Sanders, S.J.; Geesaman, D.F.; Henning, W.; Kovar, D.G.; Olmer, C.; Paul, M.; Schiffer, J.P. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

Angular distributions were measured at $6^0 \leqq \theta$/sub c.m./ $\leqq 50^0$ for the $^{24}Mg(^{16}O,^{12}C)^{28}Si$ reaction at E/sub c.m./ = 26.3, 26.9, 27.8, 29.4, 30.1, 31.6, 32.4, and 33.8 MeV. The data were analyzed in terms of a DWBA amplitude plus a resonant term at each energy. The results confirm the hypothesis that two overlapping resonants are required to fit the data around E/sub c.m./ = 31 MeV; at 28 MeV one resonant amplitude seems to be sufficient. This analysis demonstrates that the structures observed at forward and backward angles can be explained in terms of interfering direct and resonant amplitudes. 1 figure. (RWR)

14488 (ANL—79-40, pp 41-42) **Search for resonant structure in the $^{24}Mg(^{16}O,^{12}C)$ reaction to states in ^{28}Si between 5 and 12-MeV excitation energy.** Sanders, S.J.; Geesaman, D.F.; Henning, W.; Kovar, D.G.; Olmer, C.; Paul, M.; Schiffer, J.P. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

Excitation functions were measured at laboratory angles of 10.5, 12.0, and 13.5 degrees. Preliminary analysis reveals that the excitation functions for at least the three strongest states, 3^- (6.88 MeV), 5^- (9.70 MeV), and the 3^- (10.18 MeV), show evidence of structure at the $\sim$ 50% level, somewhat lower than that observed for the ground state and 2^+ (1.78 MeV) state; the structure seems to show some correlation in energy. with that for the lower states. These observations suggest that the resonance strength may be shared between several channels. 1 figure. (RWR)

14489 (ANL—79-40, pp 45-46) **Fusion of ^{12}C + ^{24}Mg and ^{12}C + ^{26}Mg.** Daneshvar, K.; Kovar, D.G. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The detailed energy dependences of the total fusion cross sections, σ/sub fus/(E), for ^{12}C + ^{24}Mg and ^{12}C + ^{26}Mg were measured. Data were obtained for $20 \leqq$ E/sub lab/ $\leqq 60$ MeV by measuring the evaporation residues in the ΔE-E gas ionization chamber silicon detector system. Single-angle measurements (θ/sub lab = 8^0) were made in 500-keV steps, and full angular distributions were measured at several energies over the region studied. The results indicate the presence of structure of $\leqq$ 5 to 10% in σ/sub fus/ (E) for ^{12}C + ^{24}Mg, while that for ^{12}C + ^{26}Mg shows a smoother behavior; moreover, σ/sub fus/(E) for the two systems differ significantly. The fusion cross sections for the ^{12}C + ^{24}Mg system are plotted. It is found that for targets in the sd shell, the specific structure of the nuclei interacting significantly affects the fusion cross-section behavior. 1 figure. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

REFER ALSO TO CITATION(S) 14512

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 14491

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 14484, 14499

14490 (ANL—79-40, pp 58-60) **Energy dependence of the inelastic scattering of ^{16}O on ^{40}Ca.** Olmer, C.; Henning, W.; Kovar, D.G.; Paul, M.; Sanders, S.J. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

Angular distributions were measured for elastic and inelastic scattering of 45- and 75-MeV ^{16}O by ^{40}Ca. DWBA and coupled-channels calculations were performed. The two calculations produced similar results for elastic scattering. For inelastic scattering, the latter agreed well with the data at the higher energy, but significant discrepancies existed at the lower.

14491 **High resolution study of the reactions $^{54\ 56\ 58}Fe(^{16}O, ^{12}C)^{58\ 60\ 62}Ni$ and a comparison with (^6Li, d) α-transfer spectroscopy.** Hanson, D.L.; Stein, N.; Sunier, J.W.; Woods, C.W.; Hansen, O. (Los Alamos Scientific Lab., NM (USA)). *Nucl. Phys., A;* **321**: No. 2, 471-489(4 Jun 1979)

Spectra and angular distributions for the reactions $^{54\ 56\ 58}Fe(^{16}O, ^{12}C)^{58\ 60\ 62}Ni$ (E/sub x/ = 0.0-4.5 MeV) have been measured at 50 MeV with an energy resolution of 45-80 keV using a Q3D spectrograph. The selectivity of the (^{16}O, ^{12}C) reaction is found to be very similar to the (^6Li, d) reaction. The close corre-

spondence recently noted between the (^{6}Li, d) spectra and levels strongly excited in (t, p) and (^{3}He, n) two-nucleon transfer reactions is also observed to be present for the (^{16}O, ^{12}C) reaction. Relative α spectroscopic factors for (^{16}O, ^{12}C) and (^{6}Li, d) obtained in a DWBA analysis assuming direct one-step α-cluster transfer are in very good quantitative agreement. Unnatural parity states, whose excitation is forbidden in the DWBA α-cluster approximation, are observed to be very weakly populated. These results, together with previous work on s-d shell and Ni targets, strongly suggest that the spectroscopic information provided by the (^{16}O, ^{12}C) and (^{6}Li, d) reactions is essentially the same and that this information may be reliably extracted by DWBA analysis.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

REFER ALSO TO CITATION(S) 14512

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 14491

14492 (ANL—79-40, pp 85-86) **Level structure of ^{67}Ge.** Murphy, M.J.; Davids, C.N. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The structure of ^{67}Ge was studied by in-beam gamma-ray spectroscopy. Thirty-one excited states up to 2.6 MeV in ^{67}Ge were identified, and more than sixty gamma rays were placed in the level scheme. The results of gamma-ray angular-distribution measurments uniquely determined the spins of the lowest-lying states, and provided rough values for the E2/M1 mixing ratios of prominent gamma transitions of these states. 1 figure, 1 table. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 14480

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

14493 (LA-UR—80-235) **Generalized seniority scheme for bands in odd-A nuclei.** Gai, M.; Arima, A.; Strottman, D. (State Univ. of New York, Stony Brook (USA); Tokyo Univ. (Japan). Dept. of Physics; Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 43p. (CONF-800213—3). Dep. NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

The microscopic generalized seniority scheme is applied for the description of bands in odd-A nuclei. A perturbation expansion in terms of the core-particle interaction is performed. The first-order correction for the band head and the first member of the band is discussed. The specific band structure of a given nucleus, as well as the systematic trend of bands, is described in an explicit N-dependent analytical formula. This formula involves a linear dependence on N which arises from the first-order perturbation expansion. This term is shown responsible for the large deviation of the $11/2^{-}$ $\Delta J=2$ band spacing in I isotopes from the spacing of the Te core. All observed band structures of an odd-A nucleus arise from one simple core-particle coupling. Hence decoupled-E2 bands and strongly coupled $\Delta J=1$ bands, particle or hole bands of low-spin or high-spin orbits, all follow one simple N-dependence. This uniformity of bands is manifested in E2 bands in $_{53}$I isotopes and $\delta J=1$ bands in $_{51}$Sb that have the same $_{52}$Te cores. For the calculations a particle-particle force with a large contribution from a g δ force is used with a coupling constant that is deduced from ^{210}Pb. 1 figure.

NUCLEAR REACTIONS AND SCATTERING

14494 (BNL-NCS—27050) **Status of radiative widths, neutron strength functions and improved evaluation using the Lane-Lynn theory.** Mughabghab, S. (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract EY-76-C-02-0016. 16p. (CONF-791223—4). Dep. NTIS, PC A02/MF A01.

From NEANDC specialist meeting on neutron cross sections of fission product nuclei; Bologna, Italy (12 Dec 1979).

The s- and p-wave neutron strength functions and average radiative widths of fission product nuclides are reviewed. The direct capture mechanism of Land and Lynn is quantitatively varified for the two reactions ^{42}Ca(n,γ) ^{43}Ca and ^{136}Xe(n,γ) ^{137}Xe. Thermal capture cross sections of ^{132}Te and ^{126}Sn are estimated with the aid of the Lane-Lynn theory. 7 figures, 1 table.

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 14498

14495 (BNL-NCS—27119) **Possible oblate rotational bands in N=84 nuclides.** Peker, L.K.; Tuli, J.K. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract EY-76-C-02-0016. 3p. (CONF-800213—7). Dep. NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

Strong-coupling rotational bands built on 11^{-} [$33/2^{+}$ for odd-A] states with configuration ν(i/sub 13/2/, h/sub 9/2/) [π(h/sub 11/2/) ν(i/sub 13/2/, h/sub 9/2/) are off-A] were identified in N=84 nuclei with Z $\leqq$ 65. These are the first levels observed in this region with proven oblate deformation. 3 figures.

NUCLEAR REACTIONS AND SCATTERING

14496 (CONF-791219—2) **Neutron emission in deeply inelastic and fusion-evaporation reactions of 208-MeV ^{16}O with ^{93}Nb.** Petitt, G.A.; Ferguson, R.L.; Gavron, A. (Georgia State Univ., Atlanta (USA); Oak Ridge National Lab., TN (USA); Washington Univ., St. Louis, MO (USA); Vanderbilt Univ., Nashville, TN (USA)). 1979. Contract W-7405-ENG-26. 6p. Dep. NTIS, PC A02/MF A01.

From International symposium on Continuum Spectra of Heavy Ion Reactors; San Antonio, TX, USA (3 Dec 1979).

Neutrons emitted in coincidence with deeply inelastic fragments or with evaporation residues were measured in the 208-MeV ^{16}O on ^{93}Nb reaction. A significant fraction of the neutrons associated with deeply inelastic reactions and emitted in the forward direction cannot be attributed to evaporation from fully accelerated fragments, and must be due to nonequilibrium neutron emission mechanisms. Nonequilibrium neutron emission is considerably less important in the fusion reaction. 3 figures.

14497 (CONF-800114—2) **Influence of nuclear structure on heavy-ion fusion at subbarrier energies.** Stokstad, R.G. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 37p. Dep. NTIS, PC A03/MF A01.

From 3. symposium on nuclear physics; Oaxtepec, Mexico (3 Jan 1980).

Measurements of the cross section for fusion of projectiles of ^{16}O and ^{40}Ar with isotopes of Sm were made at energies below the fusion barrier. The experimental identification of the evaporation residues proceeds through the off-line detection of x-rays from radioactive product nuclei. Large differences are observed in the thresholds for fusion with vibrational and rotational target nuclei. 18 figures

14498 (LA-UR—80-79) **Fragmentation of elementary excitations in the transitional molybdenum isotopes.** Flynn, E.R.; Ajzenberg-Selove, F.; Brown, R.E.; Cizewski, J.A.; Sunier, J.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 3p. (CONF-800213—2). Dep. NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

A two-nucleon-transfer study of the molybdenum isotopes was carried out to investigate the transitional character of these nuclei. The results indicate that the lighter nuclei have spherical shell model characteristics whereas the heavier nuclei are rapidly becoming deformed. 1 table.

14499 (LBL—10356) **Gamma-rays from deep inelastic collisions.** Stephens, F.S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1979. Contract W-7405-ENG-48. 43p. (CONF-790751—3). Dep. NTIS, PC A03/MF A01.

From International summer school on heavy ion nuclear reactions; Varenna, Italy (9 Jul 1979).

The γ-rays associated with deep inelastic collisions can give information about the magnitude and orientation of the angular momentum transferred in these events. In this review, special emphasis is placed on understanding the origin and nature of these γ-rays in order to avoid some of the ambiguities that can arise. The experimental information coming from these γ-ray studies is reviewed, and compared briefly with that obtained by other methods and also with the expectations from current models for deep inelastic collisions. 15 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

14500 (LA-UR—80-102) **Rotation-vibration structure of even-A samarium and gadolinium isotopes.** Hsu, H.H.; Williams, S.A. (Los Alamos Scientific Lab., NM (USA); Ames Lab., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1980. Contract W-7405-ENG-36. 4p. (CONF-800213—5). Dep. NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

The extended rotation-vibration model, which consists of an asymmetric rotor and breathing mode deformation vibrations, was applied to several even-A samarium and gadolinium isotopes. The comparison between the theoretical and experimental energy levels and the comparison with other model calculations are presented. Also shown are the comparison between the experimental and theoretical B(E2) ratios for the isotopes studied. 1 figure, 2 tables.

NUCLEAR REACTIONS AND SCATTERING

14501 (COO—3496-73) **Light-particle emission as a probe of dissipation and deexcitation mechanisms in heavy-ion reactions.** Schroeder, W.U. (Rochester Univ., NY (USA). Dept. of Chemistry and Physics). Dec 1979. Contract EY-76-S-02-3496. 32p. (UR-NSRL—208; CONF-791219—5). Dep. NTIS, PC A03/MF A01.

From International symposium on Continuum Spectra of Heavy Ion Reactors; San Antonio, TX, USA (3 Dec 1979).

The relevance of studies of light-particle emission associated with damped nuclear reactions for investigating properties of the reaction mechanism, in particular of the energy dissipation mechanism, is discussed. Processes of instantaneous particle emission are reviewed, as related to heavy-ion reactions. Methods are outlined concerning information on the conditions of the intermediate nuclear system at scission revealed in the processes of statistical particle evaporation from the reaction fragments. They are employed in studies of neutron emission in the damped reactions $^{165}Ho + ^{56}Fe$ and $^{165}Ho + ^{136}Xe$, yielding evidence for a rapid thermalization and a relaxation of the mass-to-charge asymmetry of the system. Progress is reported for attempts to achieve a unified description of energy dissipation, nucleon exchange, and particle emission in damped nuclear reactions. 19 figures, 1 table.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

ENERGY LEVELS AND TRANSITIONS

14502 (ANL—79-40, pp 51-53) **High-spin yrast states in ^{151}Dy.** Khoo, T.L.; Smither, R.K.; Kutschera, W.; Ahmad, I.; Davids, C.N.; Levenson, S.; Haas, B.; Haeusser, O.; Andrews, H.R.; Horn, D.; Sharpey-Schafer, J.F.; Taras, P.; Ward, D. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

The (^{32}S, 5n) reaction was used to identify states of ^{151}Dy with spins of up to 71/2. Two isomers were identified which had the following properties: E = 4905, 6033 keV; I/sup π/ = 41/2/sup (-); T/sub 1/2/ = 6, 13 ns. The yrast energies of ^{151}Dy increase linearly with I(I + 1) on the average, for I $\geq$ 25/2. Plots of E vs I(I + 1) are shown for the yrast states of ^{151}Dy and ^{152}Dy. The effective moments of inertia, I, are 134 and 142 MeV^{-1}, respectively. The rigid-sphere value is 120 MeV^{-1}. The excess over the rigid sphere value is due to either shell structure effects (high density of large-j valence orbits), or oblate deformation at high spin, or a combination of the two. 1 figure. (RWR)

14503 (CONF-800213—8) **Reduced E1, E2, and E3 transition probabilities for transitions in $^{150-160}$Gd and $^{160-164}$Dy.** McGowan, F.K.; Milner, W.T.; Stelson, P.H. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 3p. Dep. NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

Direct E2 and E3 Coulomb excitation of 2^+ and 3^- states with 13.5-MeV ^{4}He ions on isotopically enriched targets of $^{150-160}$Gd and $^{160-164}$Dy was measured by means of γ-ray spectroscopy. Several 2^+ states and 3^- octupole vibrational states were identified in each nucleus. The B(Eλ, 0 $\rightarrow$ J = λ) is obtained for excitation of each state, and information is given on the reduced transition probabilities for the different decay modes of these states. The experimental results are compared with theoretical predictions of nuclear models describing these states. 2 tables.

14504 (LBL—10137) **New developments in gamma-ray continuum spectroscopy.** Diamond, R.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1979. Contract W-7405-ENG-48. 16p. (CONF-791219—3). Dep. NTIS, PC A02/MF A01.

From International symposium on Continuum Spectra of Heavy Ion Reactors; San Antonio, TX, USA (3 Dec 1979).

Much information on states of high spin (30 to 60h-bar) comes from γ-ray spectroscopy of their numerous de-excitation cascades. In such studies selection of particular (high) spin regions are made through use of multiplicity filters and total-energy spectrometers. The nuclei investigated so far, whether initially near-spherical or deformed, all appear to become deformed rotors at high spin, and effective moments of inertia can be obtained. A new technique of determining energy correlations among coincident transitions in the cascade offers great promise for the future. 9 figures.

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 14502

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 14480, 14497, 14499, 14501, 14507

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

REFER ALSO TO CITATION(S) 14501

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 14506

14505 (LA-UR—80-46) **Two-neutron transfer study on ^{195}Pt.** Cizewski, J.A.; Flynn, E.R.; Brown, R.E.; Sunier, J.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800213—1). Dep. NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

The ^{195}Pt(t,p)^{197}Pt reaction was investigated. Three states below 1 MeV are populated with a large fraction of the L = 0 strength, which is seen in the even-to-even cases. This is in contrast to other (p,t) and (t,p) studies on Pt targets, where the L = 0 strength is concentrated in the ground state. 1 figure, 1 table.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 14499, 14501, 14505

14506 (ANL—79-40, pp 128-130) **Absence of large M1 excitations in ^{208}Pb below 8.4 MeV.** Holt, R.J.; Jackson, H.E.; Laszewski, R.M.; Specht, J.R. 1979.

In Physics Division annual review, 1 April 1978-31 March 1979.

A very high-resolution measurement of the ^{208}Pb(γ-n$_0$)^{207}Pb reaction was performed by use of the unique picopulse and the newly-installed neutron flight paths at the ANL electron linac facility. The 7.99-MeV resonance (E/sub n/ = 610 keV) exhibited a level-level interference pattern with the 7.98-MeV, E1 resonance in ^{208}Pb. 1 figure. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 14521

14507 (LBL—9886) **Transfer products from the reactions of heavy ions with heavy nuclei.** Thomas, K.E. III. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 180p. Dep. NTIS, PC A09/MF A01.

Thesis.

Production of nuclides heavier than the target from ^{86}Kr- and ^{136}Xe-induced reactions with ^{181}Ta and ^{238}U was investigated. Attempts were made to produce new neutron-excess Np and Pu isotopes by the deep inelastic mechanism. No evidence was found for ^{242}Np or ^{247}Pu. Estimates were made for the production of ^{242}Np, ^{247}Pu, and ^{248}Am from heavy-ion reactions with uranium targets. Comparisons of reactions of ^{86}Kr and ^{136}Xe ions with thick ^{181}Ta targets and ^{86}Kr, ^{136}Xe and ^{238}U ions with thick ^{238}U targets indicate that the most probable products are not dependent on the projectile. The most probable products can be predicted by the

equation Z - Z/sub target/ = 0.43 (A - A/sub target/) + 1.0. The major effect of the projectile is the magnitude of the production cross section of the heavy products. Based on these results, estimates are made of the most probable mass of element 114 produced from heavy-ion reactions with ^{248}Cm and ^{254}Es targets. These estimates give the mass number of element 114 as ~ 287 if produced in heavy-ion reactions with these very heavy targets. Excitation functions of gold and bismuth isotopes arising from ^{86}Kr- and ^{136}Xe-induced reactions with thin ^{181}Ta targets were measured. These results indicate that the shape and location (in Z and A above the target) of the isotopic distributions are not strongly dependent on the projectile incident energy. Also, the nuclidic cross sections are found to increase with an increase in projectile energy to a maximum at approximately 1.4 to 1.5 times the Coulomb barrier. Above this maximum, the nuclidic cross sections are found to decrease with an increase in projectile energy. This decrease in cross section is believed to be due to fission of the heavy products caused by high excitation energy and angular momentum. 111 references, 39 figures, 34 tables.

14508 Measurement of the Doppler effect in uranium-238. Tsang, F.Y. (EG and G Idaho, Inc., Idaho Falls); Brugger, R.M. *Nucl. Sci. Eng.;* **72**: No. 1, 52-64(Oct 1979).

The Doppler effect of ^{238}U metal and ^{238}U in U_3O_8 was studied by using beams of filtered neutrons at 24 +- 0.9 keV and 144 +- 12 keV from the University of Missouri Research Reactor (MURR) Facility. The Doppler effect is the broadening of the widths of the nuclear resonances in the total cross section due to the thermal motion of the nuclei. The effective average total cross sections (EATCS) for both kinds of samples were measured with good geometry transmission measurements as functions of sample thickness and temperature to show the Doppler effect. The temperature of the samples ranged from 38 to 1100 K. Temperature-related density effects were removed by simultaneously measuring the attenuation of gamma rays passing through the samples. The EATCS data as function of sample thickness at room temperature were fit with a nuclear cross section calculated from a ladder of resonances in the center-of-mass system. This ladder was generated from a set of synthesized nuclear parameters. The best fits to the cross sections when extrapolated to zero thickness, give 13.5 +- 0.2 b at 24 keV and 11.9 +- 0.2 b at 144 keV. The value at 24 keV agrees with the ENDF/B-IV, while the value at 144 keV is ~ 4% greater.An ideal gas model including an effective mass, M/sub eff/, and an effective temperature, T/sub eff/, was used to Doppler broaden the calculated nuclear cross sections. With this model, good agreement was obtained with the EATCS data for all sample thickness at all temperatures with an M/sub eff/ of 238 amu for the ^{238}U metal and 400 amu for ^{238}U in U_3O_8. The temperature dependence of t/sub eff/ was determined by calculating the total energy by use of Debye frequency θ/sub v/ distributions. In these calculations, the Debye temperatures, θ/sub D/, that provided the best fits were θ/sub D/ = 260 K for the metal and θ/sub D/ = 545 K for U_3O_8. 9 figures, 1 table.

SPONTANEOUS AND INDUCED FISSION

14509 (ANL/NDM—45) **Evaluation of ^{235}U(n,f) between 100 keV and 20 MeV.** Poenitz, W.P. (Argonne National Lab., IL (USA)). Jul 1979. Contract W-31-109-ENG-38. 86p. Dep. NTIS, PC A05/MF A01.

The ^{235}U(n,f) cross section is evaluated in the energy range from 100 keV to 20 MeV. Experimental data are included up to the 1978 Harwell Conference on Neutron Physics. The evaluation methodology is discussed in detail. The shape and the normalization of the cross section are evalutated in separate steps. An extensive comparison of the evaluation result with experimental data sets is made. The shape of the cross section obtained in a preliminary version of the present evaluation and a normalization factor extracted from data provided within the framework of this evaluation were used by the Subcommittee on Standards and Normalizations of the Cross Sections Evaluation Working Group to establish ^{235}U(n,f) for ENDF/B-V above 100 keV. 20 figures, 6 tables.

14510 (ANL/NDM—50) **Prompt-fission-neutron spectra of ^{233}U, ^{235}U, ^{239}Pu and ^{240}Pu relative to that of ^{252}Cf.** Smith, A.; Guenther, P.; Winkler, G.; McKnight, R. (Argonne National Lab., IL (USA)). Sep 1979. Contract W-31-109-ENG-38. 21p. Dep. NTIS, PC A02/MF A01.

The prompt-neutron-induced-fission spectra of ^{233}U, ^{235}U, ^{239}Pu, and ^{240}Pu are measured relative to the prompt-spontaneous-fission-neutron spectrum of ^{252}Cf. The fission of ^{233}U, ^{235}U, and ^{239}Pu is induced by ~ = 550-keV neutrons, and that of ^{240}Pu, by ~ = 850-keV neutrons. The emitted fission neutrons are observed over the energy range ≦ 0.5 to 10.0 MeV by use of time-of-flight techniques. Analysis of the measured values indicates that the average-fission-neutron energies are -123 +- 30 (^{233}U), -157 +- 24 (^{235}U), -76 +- 29 (^{239}Pu), and -46 +- 29 (^{240}Pu) keV relative to the energy for ^{252}Cf. The experimental results are compared with those of ENDF/B-V, and a simple behavior of average-prompt-fission-neutron energies is suggested.

NUCLEAR THEORY

14511 (LA-UR—80-119) **Finite boson representation of monopole and quadrupole Fermi pairs.** Ginocchio, J.N. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800213—4). Dep. NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

The monopole and quadrupole fermion pairs of a monopole and quadrupole pairing model can be represented by a finite expansion in terms of monopole and quadrupole bosons.

NUCLEAR STRUCTURE

REFER ALSO TO CITATION(S) 14478

NUCLEAR REACTIONS AND SCATTERING

14512 (CONF-800114—1) **Semi-realistic interactions for scattering from nuclei.** Satchler, G.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 37p. Dep. NTIS, PC A03/MF A01.

From 3. symposium on nuclear physics; Oaxtepec, Mexico (3 Jan 1980).

It is of considerable interest to understand data from nucleon-nucleus and nucleus-nucleus scattering in terms of the individual nucleon motions and interactions, and to relate them in detail to other information. Work along these lines with a realistic interaction is reviewed under the following topics: the effective interaction, properties of the effective interaction, simplified effective interactions, density dependence of the interaction, applications to nucleon scattering, double folding for composite projectiles, applications to alpha particle scattering, and applications to heavy-ion scattering. Typical results are shown for ^{60}Ni + n, ^{60}Ni + p, α + ^{40}Ca, ^{16}O + ^{40}Ca, ^{40}Ca + ^{40}Ca, and ^{16}O + ^{28}Si. 17 figures, 1 table. (RWR)

14513 (ORO—5126-97) **New methods in nuclear reaction theory.** Redish, E.F. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1979. Contract EY-76-S-05-5126. 33p. (CONF-790484—4). Dep. NTIS, PC A03/MF A01.

From American Physical Society meeting; Washington, DC, USA (23 Apr 1979).

Standard nuclear reaction methods are limited to treating problems that generalize two-body scattering. These are problems with only one continuous (vector) degree of freedom (CDOF). The difficulty in extending these methods to cases with two or more CDOFs is not just the additional numerical complexity: the mathematical problem is usually not well-posed. It is hard to guarantee that the proper boundary conditions (BCs) are satisfied. Since this is not generally known, the discussion is begun by considering the physics of this problem in the context of coupled-channel calculations. In practice, the difficulties are usually swept under the rug by the use of a highly developed phenomenology (or worse, by the failure to test a calculation for convergence). This approach limits the kind of reactions that can be handled to ones occurring on the surface of where a second CDOF can be treated perturbatively. In the past twenty years, the work of Faddeev, the quantum three-body problem has been solved. Many techniques (and codes) are now available for solving problems with two CDOFs. A method for using these techniques in the nuclear N-body problem is presented. A set of well-posed (connected kernal) equations for physical scattering operators is taken. Then it is shown how approximation schemes can be developed for a wide range of reaction mechanisms. The resulting general framework for a reaction theory can be applied to a number of nuclear problems. One result is a rigorous treatment of multistep transfer reactions with the possibility of systematically generating corrections. The application of the method to resonance reactions and knock-out is discussed. 12 figures.

14514 Antisymmetrization effects on the effective internuclear potential. Lemere, M.; Stubeda, D.J.; Tang, Y.C. (Minnesota Univ., Minneapolis (USA). School of Physics); Horiuchi, H. (Kyoto Univ. (Japan). Dept. of Physics). *Nucl. Phys., A;* **320**: No. 2, 449-478(21 May 1979).

The effects of internuclear antisymmetrization in nucleus-nucleus scattering are studied by examining the structure of the exchange-Hamiltonian kernel function in the resonating group formulation. By investigating the features of the effective local potentials which are constructed to yield the same Born scattering amplitudes as the various nucleon-exchange terms in this kernel function, it is found that, among all exchange terms, the one-exchange and core-exchange terms have the largest influence. In addition, this investigation shows that the one-exchange terms, giving rise to a Wigner-type effective potential, are generally important in all scat-

tering systems and over a wide energy range, while the core-exchange terms, giving rise to a Majorana-type effective potential, are generally important when the nucleon-number difference of the interacting nuclei is rather small. Based on these results, it can therefore be concluded that, if a local effective potential is adopted to analyze experimental scattering results, then the real central part of the effective potential in this model must, in general, contain a Majorana exchange component or an odd-even l-dependence. Explicit resonating-group calculations in $^3He+\alpha$ and $\alpha+^{16}O$ systems, where contributions from individual exchange terms are studied, have also been performed. From this study, one finds that the conclusion mentioned above, reached in the Born approximation, may in fact be valid even in the lower-energy region.

NUCLEAR MODELS

14515 (LA-UR—80-103) **Intrinsic state for the interacting boson model.** Ginocchio, J.N.; Kirson, M.W. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800213—6). Dep. NTIS, PC A02/MF A01.

From Band structure and nuclear dynamics conference; New Orleans, LA, USA (28 Feb 1980).

A form is suggested for an intrinsic state for the interacting boson model that allows a connection to be made with the familiar geometrical description of collective nuclei.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 13042, 14519

14516 (LA—8113-MS) **Calculation of cell volumes and surface areas in MCNP.** Hendricks, J.S. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 30p. Dep. NTIS, PC A03/MF A01.

MCNP is a general Monte Carlo neutron-photon particle transport code which treats an arbitrary three-dimensional configuration of materials in geometric cells bounded by first- and second-degree surfaces, and some special fourth-degree surfaces. It is necessary to calculate cell volumes and surface areas so that cell masses, fluxes, and other important information can be determined. The volume/area calculation in MCNP computes cell volumes and surface areas for cells and surfaces rotationally symmetric about any arbitrary axis. 5 figures, 1 table.

14517 (PNL—2850(Pt.4), pp 2.1-2.19) **Radiation physics.** Feb 1979.

In Pacific Northwest Laboratory annual report for 1978 to the DOE Assistant Secretary for Environment. Part 4. Physical sciences.

Research is summarized in radiation physics, ionization processes, track structure, and energy transport. (JFP)

14518 **Analysis of the variance in Monte Carlo calculations.** Dubi, A. (Los Alamos Scientific Lab., NM). *Nucl. Sci. Eng.;* **72**: No. 1, 108-110(Oct 1979).

The problem of analyzing the variance in a Monte Carlo calculation is addressed. The batch analysis method is considered, where one uses the average of contributions of k particles as an independent random variable, versus the one-particle analysis method, where k = 1. It is shown through general statistical considerations that the one-particle method yields more reliable estimates of the variance.

SHIELDING CALCULATIONS AND EXPERIMENTS

REFER ALSO TO CITATION(S) 14519

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 14516

14519 (LA—8201-MS) **Application of biasing techniques to the contributon Monte Carlo method.** Dubi, A.; Gerstl, S.A.W. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 45p. Dep. NTIS, PC A03/MF A01.

Recently, a new Monte Carlo Method called the Contribution Monte Carlo Method was developed. The method is based on the theory of contributions, and uses a new receipe for estimating target responses by a volume integral over the contribution current. The analog features of the new method were discussed in previous publications. The application of some biasing methods to the new contribution scheme is examined here. A theoretical model is developed that enables an analytic prediction of the benefit to be expected when these biasing schemes are applied to both the contribution method and regular Monte Carlo. This model is verified by a variety of numerical experiments and is shown to yield satisfying results, especially for deep-penetration problems. Other considerations regarding the efficient use of the new method are also discussed, and remarks are made as to the application of other biasing methods. 14 figures, 1 tables.

14520 **Application of pulsed neutron technique for integral neutron cross-section tests in the MeV range.** Nargundkar, V.R. (Bhabha Atomic Research Centre, Bombay (India). Neutron Physics Section). pp 405-412 of Proceedings of the symposium on reactor physics. Bombay; Department of Atomic Energy (1978).

From Symposium on reactor physics; Bombay, India (1 Mar 1976).

The spectra of neutrons scattered by several elements and compounds for an incident beam of 14 MeV neutrons have been studied by the time of flight method at Livermore in the so called 'Livermore Pulsed Sphere Program'. The measurements have been compared with results of Monte Carlo and neutron transport codes to provide checks on the input cross-sections. Similar measurements have been carried out at Oak ridge for incident neutron energies between 1 MeV to 20 MeV with a view to obtain information useful for neutron shielding calculations. The salient features of these measurements and proposals for an experimental program for obtaining data of interest are reviewed.

14521 **Neutron and gamma-ray spectra from ^{232}Th, ^{235}U, ^{238}U, and ^{239}Pu after bombardment with 14-MeV neutrons.** Hansen, L.F.; Wong, C.; Komoto, T.T.; Pohl, B.A.; Goldberg, E.; Howerton, R.J.; Webster, W.M. (Univ. of California, Livermore). *Nucl. Sci. Eng.;* **72**: No. 1, 35-51(Oct 1979).

The neutron and gamma-ray leakage spectra from pulsed spheres having a radius equal to 1.0 mean-free path (mfp) for 14-MeV neutrons in ^{232}Th, ^{235}U (with radii of 0.7 and 1.5 mfp), ^{238}U (with radii of 0.8 and 2.8 mfp), and ^{239}Pu (with radii of 0.7 and 1.25 mfp) were measured by using time-of-flight techniques. The neutron spectra were measured between 0.9 and 15 MeV with stilbene and NE-213 scintillators. For the gamma rays, the electron recoil spectra were measured between 0.35 and 8 MeV with the NE-213 detector only. Pulse-shape discrimination and flight paths of $\sim$ 10 m were used in these measurements. The measured spectra are compared with calculations carried out with TARTNP, a coupled neutron-photon Monte Carlo transport code. The Lawrence Livermore Laboratory ENDL (neutron and photon cross sections) and ENDF/B-IV libraries were used in these calculations. In the region between 10 and 15 MeV, the calculated neutron spectra are in good agreement with the measurements (+-5%). The maximum discrepancy observed for the neutrons between 0.9 and 10 MeV is 30%. The notable exception is ^{232}Th, where calculations carried out with the ENDF/B-IV underestimate by a factor of 2 the neutron emission between 5 and 10 MeV. The gamma-ray emission calculations were carried out only with ENDL, because of its overall better representation of the neutron measurements; ENDL overestimates the gamma-ray production, with discrepancies ranging between 5 and 20%. However, use of the measured detector efficiency would reduce the maximum discrepancy to $<$ 13%. To facilitate the use of the neutron data for calculational purposes by other laboratories, an experimental one-dimensional neutron energy spectrum is given for each measurement. 10 figures, 7 tables.

MEDICAL PHYSICS

REFER ALSO TO CITATION(S) 14122

RADIATION SOURCE CALIBRATION AND STANDARDIZATION

14522 (IDO—1570-T32) **Recommended standards for gamma-ray energy calibration (1979).** Helmer, R.G.; Van Assche, P.H.M.; Van Der Leun, C. (EG and G Idaho, Inc., Idaho Falls (USA); Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). 1979. Contract EY-76-C-07-1570. 20p. Dep. NTIS, PC A02/MF A01.

A consistent set of γ-ray energies, all with uncertainties of at most 10 ppM, is recommended for use in the energy calibration of γ-rays spectra. The γ rays listed are all from commercially available sources. The half-lives of the isotopes selected are generally at least 30 days. The γ-ray energies, in the range E/sub γ/ = 60 to 6100 keV, are all based on the value of 411 804.4 +- 1.1 eV for the γ ray from the decay of ^{198}Au. The energy of the 6129-keV line in ^{16}O, which is the γ ray with the highest energy of the present set, was also measured relative to another standard; the two values are consistent. 2 figures, 2 tables.

DOSIMETRY

REFER ALSO TO CITATION(S) 13042, 14306, 14350

14523 (PB—292111) **Nationwide survey of cobalt-60 teletherapy dosimetry. Technical note.** Soares, C.G.; Ehrlich, M. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Aug 1978. 45p. NTIS, PC A03/MF A01.

Between September 1974 and December 1977 the National Bureau of Standards, in cooperation with the Bureau of Radiological Health, performed a study of the accuracy with which a prescribed absorbed dose of cobalt-60 gamma radiation is delivered to a specified point in a water phantom. Approximately two-thirds of the cobalt-60 teletherapy units in the U.S. were surveyed by mail, using a rugged thermoluminescence dosimetry system. The dose given by prticipants was evaluated from dosimeter response, and information supplied by participants was used to check their computations of the dose delivered. In this nationwide study, 83 percent of the units surveyed yielded dose interpretations within 5 percent of the requested dose, 13 percent yielded differences between 5 and 10 percent, and 4 percent of the dose interpretations differed by more than 10 percent from the dose requested. Sources of discrepancies are discussed, and the results of this survey are compared with those of other dosimetry surveys.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 13253, 14453

14524 (BNL—26960) **Many-body problem in one-dimension.** Emery, V.J. (Brookhaven National Lab., Upton, NY (USA)). Nov 1979. Contract EY-76-C-02-0016. 35p. (CONF-7909119—1). Dep. NTIS, PC A03/MF A01.

From 2. Kyoto summer institute on physics of low dimensional systems; Kyoto, Japan (7 Sep 1979).

This work attempts to give a qualitative feeling for the more important physical ideas involved with the study of many-body systems in one dimension, and considers a particular strong-coupling model. This model provides an excellent description of the chains of mercury ions in Hg/sub 3-delta/AsF_6; some of the predictions of the theory can be checked by x-ray and neutron diffraction. Much of the physics of nearly one-dimensional materials is concerned with understanding the possible types of phase transition that may take place, and establishing the conditions in which one or another will be predominant. The most significant feature of purely one-dimensional systems is the dominant effect of fluctuations. The paper is organized as follows: introduction; qualitative aspects of one-dimensional systems (general survey, mathematical model, qualitative discussion of strong coupling - strong attractive U, strong repulsive U, large V); strong coupling between parallel spins (independent spin systems, coupling between opposite spins); mercury chains; electrons with arbitrary coupling; boson representations of operators; and classical Coulomb gas. (RWR)

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 13890, 13903, 13915

THEORETICAL PHYSICS

STATISTICAL PHYSICS AND THERMODYNAMICS

14525 **Relationship between surface tension and energy, interfacial energy and lattice friction.** Jagannadham, K.; Marcinkowski, M.J. (Univ of Md, College Park). *J. Mater. Sci.;* **14**: No. 7, 1717-1732(Jul 1979).

Any surface, in order to decrease its surface energy, contracts. It is shown for the first time that this contraction is formally equivalent to the introduction of a continuous distribution of surface dislocations. Equilibrium is attained when the increase in strain energy associated with these surface dislocations just balances the corresponding decrease due to the reduction in free surface area. Numerical calculations have been carried out for finite solid and liquid bodies as well as for liquid droplets in contact with solids. These findings suggest that it is possible to reformulate the behavior of liquids in terms of dislocation theory in a much more general way than has hitherto been done.

ELECTRICITY AND MAGNETISM

14526 (UCRL—52822) **Imaging of linear source distributions.** Miller, E.K.; Lager, D.L.; Okada, J.T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1979. Contract W-7405-ENG-48. 33p. Dep. NTIS, PC A03/MF A01.

An approach based on Prony's method is used to find the spatial poles of straight wires of varying length and radius from the far-field patterns. For the antenna case, poles having the largest residues are found near the feed region and antenna ends; smaller ones are found outside these regions. The poles are attributed to radiation from the exciting source and wire ends, due to charge acceleration, and from a slightly damped traveling wave. In the scattering case, the poles with the largest residues are located at the wire's ends for near-axial incidence and are again due to end radiation. By examination of the residue magnitudes as a function of wire radius, a correlation is found with radiation from the feed region of an infinite antenna and from the ends of a semi-infinite antenna. 19 figures.

MATHEMATICAL PHYSICS

REFER ALSO TO CITATION(S) 14518

FUSION ENERGY

14527 (MATT—1(Suppl.8)) **Bibliography of Plasma Physics Laboratory publications and reports, January 1-December 31, 1979.** (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1980. Contract EY-76-C-02-3073. 18p. Dep. NTIS, PC A02/MF A01.

This bibliography contains approximately 112 references of work that covers the period January through December 1979. (MOW)

14528 (NTIS/PS—79/0811) **Controlled fusion reactor design and technology-tokamak devices (citations from the international aerospace abstracts data base). Report for 1977-Jul 79.** Mauk, S.C. (New Mexico Univ., Albuquerque (USA). Technology Application Center). Aug 1979. 62p. NTIS PCN01/MF N01.

This bibliography of citations to the international literature concerns all aspects of controlled fusion reactor design and technology as applied to Tokamak devices. Included are articles concerning plasma control, plasma heating, toroidal plasmas, neutral beams, magnetic field configuration, superconducting magnets, magnetohydrodynamic stability, field coils, and magnetic coils. Articles covering Tokamak reactor design and technology are stressed. (Contains 236 citations)

14529 **Fusion power development: status and prospects.** Steiner, D. (Oak Ridge Natl Lab, Tenn). *Am. Soc. Mech. Eng., [Pap.];* No. 79-JPGC-NE-1, 1-7(1979).

The scientific progress of the Tokamak approach to fusion power generation has advanced further than alternate fusion concepts. In this paper the requirements of a Tokamak power reactor are discussed relative to the existing scientific and technological bases. A brief description of the current DOE strategy to develop fusion power generation is also presented. 36 refs.

PLASMA RESEARCH

REFER ALSO TO CITATION(S) 14451

PLASMA CONFINEMENT AND HEATING

14530 (NRL-MR—4142) **Transient tokamak.** Manheimer, W.M.; Winsor, N.K. (Naval Research Lab., Washington, DC (USA)). 21 Dec 1979. Contract EX-76-A-34-1006. 11p. Dep. NTIS, PC A02/MF A01.

A tokamak plasma, and its toroidal current, can be generated by an intense pulsed ion beam. The beam is injected into a target plasma or empty vacuum chamber and then builds the plasma around it. It is shown that ignition is theoretically possible for a dense, high field tokamak.

14531 (ORNL/TM—7159) **Microwave coupling in EBT reactor.** Uckan, N.A.; Uckan, T.; Dandl, R.A. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 19p. Dep. NTIS, PC A02/MF A01.

For a typical size ELMO Bumpy Torus (EBT) reactor (~ 1000 MWe), microwave frequencies required lie in the range of 60 to 110 GHz at power levels of 50 to 75 MW. As the frequency rises, the unloaded cavity (i.e., without plasma) quality factor Q decreases. Because of the short wavelengths of microwave heating power and the large cavity dimensions of a reactor, it is possible to apply quasi-optical principles in the efficient coupling of power to the plasma. The use of a confocal Fabry-Perot resonator with spherical mirrors is discussed; these serve to confine the microwave power to the region occupied by the plasma. The potential advantages of these resonators include high efficiency utilization of microwave power, minimal thermal burden on the cryopumping system, and significant benefit in preventing microwave leakage from the device. An esti-

mation of the unloaded cavity quality factor Q and the design considerations of Fabry-Perot resonator are given.

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 14574

14532 (PPPL—1623) **Phase locked tracking filters for interferometry.** Cutsogeorge, G. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1980. Contract EY-76-C-02-3073. 25p. Dep. NTIS, PC A02/MF A01.

Three phase locked tracking filters that have been built for use with microwave and laser interferometers are described. Block diagrams, circuit diagrams and test data are presented.

14533 (PPPL—1631) **Distribution of emitters in an elliptical source.** Silver, E.; Roney, W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1980. Contract EY-76-C-02-3073. 21p. Dep. NTIS, PC A02/MF A01.

A simple technique is presented for calculating emission profiles from elliptically shaped plasmas.

14534 (UCRL—82912) **Mechanism design of the Thomson scattering diagnostic system for the TMX east mirror plug.** Lang, D.D.; Goodman, R.K.; Jenkins, S.L.; Wilkerson, J.A.; Parkinson, J.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—96). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

This Thomson scattering diagnostic system is used to measure the electron temperature and density of the east mirror plug of the Tandem Mirror Experiment (TMX) at Lawrence Livermore Laboratory. The measurements are made by firing a high-power ruby laser pulse through the plasma where the electrons then re-radiate a small fraction of the light. Because of the velocity of the electrons, the wavelength of the re-radiated light is Doppler shifted. The width of the Doppler-shifted wavelength spectrum is a measure of the temperature of the electrons in the plasma, and the total amount of re-radiated light is proportional to the electron density.

14535 (UCRL—83056) **Z dependence of sub-keV x rays emitted by laser-produced plasmas.** Lee, P.H.Y.; Tirsell, K.G.; Campbell, E.M.; McClellan, G.; Rosen, M.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Nov 1979. Contract W-7405-ENG-48. 13p. (CONF-791135—7). Dep. NTIS, PC A02/MF A01.

From 21. annual meeting of the American Physical Society; Boston, MA, USA (12 Nov 1979).

Recent results obtained by using a 10 channel, filtered XRD detector system to record sub-keV x-ray emission from laser-irradiated targets are reported. Targets materials were Be, Al, Ti, Sn, Au and U, with Z ranging from 4 to 92. Targets were irradiated with 1ns FWHM, 1.06 μm wavelength pulses at an intensity of 5×10^{14} W/cm^2. Time-resolved x-ray emission pulses show systematic and striking variations with Z. These variations can most probably be attributed to the onset of inhibited electron conduction. Time-integrated x-ray yields are obtained as a function of target Z as well as calculated charge states anti Z, indicating the type of physical processes that give rise to the x-ray emission. Typical sub-keV x-ray spectra are presented; in some cases such as Ti where prominent lines are present, the charge state of the plasma can be directly deduced from line ratios, agreement with numerical simulation is very good.

PLASMA KINETICS - THEORETICAL

14536 (AD-A—062724) **First quarter progress report on plasma theory and simulation. Report for 1 January-31 March 1978.** Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 1 Apr 1978. Contracts N00014-77-C-0578;ERDA-EY-76-S-03-0034. 54p. Availability: Microfiche copies only.

Contents: Self-Heating of 1d Thermal Plasma; Velocity-space Ring-plasma Instability, Magnetized; Particle Trajectories in a Cusp Field; Plasmas with Field Reversal; Particle Acceleration, Gamma Ray Emission, and Sparking in Pulsars; Electrostatic 2 1/2d Code Development (EZOHAR); and Cold Beam Nonphysical Instability.

14537 (AD-A—062725) **Second quarter progress report on plasma theory and simulation. Report for 1 April-30 June 1978.** Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 1 Jul 1978. Contracts N00014-77-C-0578;ERDA-EY-76-S-03-0034. 15p. Availability: Microfiche copies only.

Contents: Drift Cyclotron Instability; Plasmas with Field Reversal; Self-Heating of 1d Thermal Plasma; ES1 Code; Electrostatic 2 1/2d Code Development (EZOHAR); ES1+ EFL Code; 1 1/2d Particle-Fluid Hybrid Model for Drift Wave Instabilities; RJET, PDP 11/04.

14538 (DOE/TIC—11094) **Supporting material for EBT-P review presentation at DOE Germantown, 9-11 January 1980: working notes.** Sheffield, J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 38p. Dep. NTIS, PC A03/MF A01.

This memorandum reviews the EBT theory of Hedrick et al., and using a model of the EBT-1/S plasma simplifies the transport equations to a few relations involving the radial electric field, radial flow, diffusion coefficients, input power and measured plasma parameters. A summary is given of EBT-1/S experimental data with reference data sets and best data sets. Theory and experiment are compared and it is shown that the electron diffusion is classical within a factor of 1.5. The proposed EBT-1/S program is reviewed and it is shown how it is designed to provide information for EBT-P in a timely fashion and fill in the gaps of knowledge in the EBT-1/S studies. Finally a brief discussion is given of EBT-Q and it is shown how the EBT-P program is designed to provide information for this ignition device.

14539 (LA-UR—80-21) **Ion beam propagation simulations.** Lemons, D.S. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 7p. (CONF-7910122—1). Dep. NTIS, PC A02/MF A01.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

A series of numerical particle-in-cell simulations of ion beam propagation have been performed with the LASL two-dimensional electromagnetic code, CCUBE. A few results for each of two different simulations are presented. They are intended to illustrate plasma effects relevant to (1) ion propagation in a relatively dense plasma background, and (2) ion vacuum propagation with comoving electrons.

14540 (NRL-MR—4156) **Stability of beta limited thermonuclear burn.** Ott, E.; Manheimer, W.M. (Naval Research Lab., Washington, DC (USA)). 28 Jan 1980. Contract EX-76-A-34-1006. 7p. Dep. NTIS, PC A02/MF A01.

The burn stability of a thermonuclear reacting plasma is examined under the assumption that a burn equilibrium exists due to the rapid increase of loss rate with plasma beta once a critical beta value is exceeded. It is found that perturbations about equilibrium generally result in a rapidly damped exponential decay and a second slow root which can be either growing (unstable) or damped. In the case where the slow root is growing, the possibility that it can be stabilized by feedback control of the rate at which neutral gas is fed into the system is considered.

14541 (PPPL—1608) **One-dimensional transport code modelling of the limiter-divertor region in tokamaks.** Ogden, J.M.; Post, D.E.; Jensen, R.V.; Seidl, F.G.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1980. Contract EY-76-C-02-3073. 42p. Dep. NTIS, PC A03/MF A01.

A model of the limiter-divertor scrape-off region has been incorporated into the BALDUR one-dimensional tokamak transport code. Simulations of PDX and ALCATOR have been carried out for ohmic and neutral beam heated cases. In particular, we have studied how the edge conditions and energy loss mechanisms of PDX depend upon plasma density, and compared our results with analytic estimates. The sensitivity of the results to changes in the transport coefficients and scrape-off model is also discussed.

14542 (PPPL—1619) **Enhanced transport in tokamaks due to toroidal ripple.** Boozer, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1980. Contract EY-76-C-02-3073. 36p. Dep. NTIS, PC A03/MF A01.

A method for evaluating transport in non-symmetric systems is developed and applied to a previously unstudied ripple collisionality regime of tokamaks. This collisionality regime, the ripple plateau, is the regime of primary importance both for present day and reactor scale tokamaks. The results can be directly applied to related systems like the toroidal Z pinch.

14543 (PPPL—1626) **Effects of impurity radiation on reversed-field pinch evolution.** Caramana, E.J.; Perkins, F.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Jan 1980. Contract EY-76-C-02-3073. 90p. Dep. NTIS, PC A05/MF A01.

The effects of impurity radiation on the evolution of a reversed-field pinch plasma are studied by means of a one-dimensional MHD simulation code that includes both plasma transport and impurity effects, and follows the plasma through a series of equilibrium states. The equations are split into two sets, one that contains plasma transport and another that contains atomic physics effects. Two codes were developed and linked together to solve the full problem. Results are presented for the ZT-S, ZT-40, and RFX experiments with a fixed set of parameters, typical or envisioned, and various concentrations of impurities. Radiation barriers are encountered, and limits are found on the acceptable level of low Z impurities that may be present in these devices. It is shown that the temperatures currently observed in the ZT-S experiment are radiation limited. Next, a criterion for radiation barrier burn-through is

derived in terms of appropriate nondimensional parameters and calibrated by comparison to the numerical simulations for the case of oxygen.

14544 (PPPL—1634) **Fluctuations, turbulence and transports in the presence of drift waves.** Okuda, H.; Sato, T.; Hasegawa, A.; Pellat, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1980. Contract EY-76-C-02-3073. 33p. Dep. NTIS, PC A03/MF A01.

Turbulence spectrum and plasma diffusion have been studied by theoretical analysis as well as by numerical simulations using a drift wave model in which electrons are assumed to follow the Boltzmann distribution, while ions are assumed to move two-dimensionally in the plane perpendicular to the magnetic field. For a plasma near local thermal equilibrium, it is found that while the ion density diffusion is negligibly small, the energy diffusion is much larger and is comparable to the test particle diffusion. In the presence of strong turbulence, $\delta n \sim n_0$, fluctuation energy is found to cascade toward long wavelength modes which accompanies the density diffusion. The resultant turbulence spectrum is isotropic in two dimensions perpendicular to the magnetic field. However, the particle diffusion coefficient remains small. When the ion density gradient is maintained by freezing the electron background density, it is found that the turbulence spectrum cascades toward smaller wavenumbers only in the direction perpendicular to the density gradient. As a result an anisotropic turbulence spectrum if formed indicating an appearance of zonal flow in this direction.

14545 (UCRL—83885) **Fokker-Planck/Transport model for neutral beam driven tokamaks.** Killeen, J.; Mirin, A.A.; McCoy, M.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 39p. (CONF-791027—2). Dep. NTIS, PC A03/MF A01.

From Autumn college on plasma physics; Trieste, Italy (16 Oct 1979).

The application of nonlinear Fokker-Planck models to the study of beam-driven plasmas is briefly reviewed. This evolution of models has led to a Fokker-Planck/Transport (FPT) model for neutral-beam-driven Tokamaks, which is described in detail. The FPT code has been applied to the PLT, PDX, and TFTR Tokamaks, and some representative results are presented.

PLASMA PRODUCTION

14546 (AD-A—062659) **Large volume plasma production by 2.45ghz microwaves. Final report, 9 December 1974-16 May 1977.** Darrah, R. (Universal Energy Systems, Inc., Dayton, OH (USA)). Dec 1977. Contract F33615-75-C-1082. 96p. NTIS, PC A05/MF A01.

The ionization and excitation of gases by three different geometries of microwave applicators are investigated. Current-voltage characteristics of a plasma with super-imposed ionization by a 2.45 GHz applicator with transport from a dc field are measured. Electron densities in helium and argon test gases were found to be greater than 10 to the 12th power/cc or thirty times higher than normal plasma cut-off densities. This applicator is also used to determine the percentage of O2a 1 del(g) produced in a pure oxygen microwave discharge. A production of up to 25% at low pressures is measured. A design which specially couples two applicators was implemented resulting in twice the power density and better uniformity. Measurement of the percentage of atomic oxygen produced in an oxygen discharge, determined by NO2 titration, indicates the efficiency of atom production for this system is as high as 43 eV/atom. Microwave power is superimposed on a dc discharge in a quartz tube He-Ne laser in this system. A twin antenna irradiator is used to apply 2.45 GHz pulsed and cw microwave power to a quartz discharge tube containing condensed mercury. The time resolved spectra of pulsed operation shows that the relative intensity of the pulsed ultraviolet output decreases as the microwave sustainer power and thus the pressure is increased.

PLASMA INSTABILITIES

14547 (AD-A—063062) **Parametric decay of extraordinary electromagnetic waves into two upper hybrid plasmons.** Grebogi, C.; Liu, C.S. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). 1977. Contract N00014-77-C-0590. 20p. NTIS, PC A02/MF A01.

The effects of self-generated magnetic field in laser produced plasmas on the parametric decay of an extraordinary electromagnetic wave into two upper hybrid plasmons is examined for arbitrary magnetic field intensity and arbitrary ratio k/k0-sub 0. Due to the presence of magnetic field, the linear Landau damping is greatly reduced and the spectrum of unstable modes is significantly modified for k lambda sub D approximately 0.2.

14548 (N—79-17705) **Non-adiabatic stability analysis of current and magnetic curvature driven modes in cold plasmas penetrated by neutral gas. Research and training programme on controlled thermonuclear fusion and plasma physics (eur-ne).** Ohlsson, D. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Aug 1978. 36p. NTIS, PC A03/MF A01.

Previous stability theories concerning electrostatic current and magnetic curvature driven modes in cold plasma mantle boundary layers are generalized. In particular, the commonly used adiabatic approximation is relaxed. In the general theory presented, important new effects associated with heat conduction, ionization, and ohmic heating are found. In combination with viscosity and resistivity., these effects introduce additional stabilizing as well as destabilizing effects. Furthermore, the present theory typically predicts similar stability properties as the adiabatic theory in the limit /d(lnT)/d(lnn)/ less than 1. However, in the limit /d(lnT)/d(lnn)/ greater than 1, the general theory predicts less favorable stability properties. These conclusions may also apply to more general types of electrostatic modes associated with density and temperature gradients in cold plasma mantle boundary layers.

14549 (N—79-17714) **Some aspects of nonlinear interaction of waves in plasmas.** Wilhelmsson, H.; Nakach, R. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). School of Electrical Engineering). 1977. 16p. NTIS, PC A02/MF A01.

Formal relations between different nonlinear coupling effects are emphasized and connections between the analysis of particular problems and general nonlinear theory are investigated. The system of equations for three interacting waves was reduced to a coupled system of two equations by considering the consequences of a large mismatch between the frequencies of the interacting waves or a large damping of one of the waves.

14550 (NRL-MR—4144) **Shear stabilized cylindrically symmetric mirror plasma.** Manheimer, W.M. (Naval Research Lab., Washington, DC (USA)). 21 Dec 1979. Contract EX-76-A-34-1006. 7p. Dep. NTIS, PC A02/MF A01.

In order to avoid flute instabilities, magnetic mirror plasmas are almost always confined in minimum B configurations. While these configurations are MHD stable, they are not cylindrically symmetric. However cylindrically symmetric configurations have certain advantages in that the coil structures are much simpler. Also it might be possible to compress a cylindrically symmetric mirror confined plasma with an imploding liner. This note proposes such a cylindrically symmetric MHD stable mirror plasma.

14551 (PPPL—1635) **Nonlinear saturation of the internal kink mode.** Park, W.; Monticello, D.A.; White, R.B.; Jardin, S.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1980. Contract EY-76-C-02-3073. 20p. Dep. NTIS, PC A02/MF A01.

A numerical study shows that in a cylindrical tokamak the internal kink mode ($m = 1$) develops nonlinearly into a helical equilibrium state that possesses a singular current sheet. In the large aspect ratio limit, the neighboring equilibria obtained agree well with the asymptotic analytic theory of Rosenbluth et al.

14552 (DOE-tr—218) **Survey of thermonuclear instabilities in a tokamak.** Mikhaylovskii, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1979. Translation source information not available. 24p. Dep. NTIS, PC A02/MF A01.

The results of the linear theory of the cyclotron instability of trapped α particles are discussed. The quasi-linear theory of this instability is described. Drift thermonuclear instabilities are then described along with Alfven instabilities caused by the peak on their energy distribution function. The cyclotron Alfven instability is then described.

PLASMA WAVE PHENOMENA

14553 (AD-A—063061) **Billouin and Raman scattering of an extraordinary mode in a magnetized plasma.** Grebogi, C.; Liu, C.S. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nov 1978. Contract N00014-77-C-0590. 21p. NTIS, PC A02/MF A01.

The effects of magnetic field on the stimulated Brillouin and Raman scattering processes are studied. The formalism applies to plasmas produced by CO2 lasers and to electron cyclotron heating of toroidal systems by an extraordinary electromagnetic wave. In the case of laser fusion the plasma is magnetized due to the self-generated dc magnetic field while in toroidal plasmas it is due to the external magnetic field. The magnetic field greatly reduces the threshold for Brillouin backscattering by the lower hybrid wave. The Raman scattering by the upper hybrid wave has substantial growth rate even for large k lambda sub D) because of the lack of Landau damping.

14554 (UCRL—82480) **Stochastic motion due to a single wave in a magnetoplasma.** Smith, G.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jun 1979. Contract W-7405-ENG-48. 12p. (CONF-7906106—4). Dep. NTIS, PC A02/MF A01.

From International workshop on intrinsic stochasticity in plasmas; Cargese, Corsica, France (18 Jun 1979).

A single electrostatic wave in a magnetoplasma causes stochastic ion motion in several physically different situations. Various magnetic fields (uniform, tokamak, and mirror) and various propagation angles with respect to the field have been studied. A brief review of this work shows that all situations can be understood using the concept of overlapping resonances. Analytical calculations of the wave amplitude necessary for stochasticity have been carried out in some cases and compared with computer and laboratory experiments. In the case of an axisymmetric mirror field the calculations predict stochastic motion of ions with energy below a threshold that depends weakly on the wave amplitude and on the scale lengths of the magnetic field. Studies with an azimuthally asymmetric field show that the asymmetry causes substantial changes in the motion of some ions.

FUSION POWER PLANT TECHNOLOGY

14555 (LA—8186-MS) **Dense Z-pinch (DZP) as a fusion power reactor: preliminary scaling calculations and sysems energy balance.** Hagenson, R.L.; Tai, A.S.; Krakowski, R.A.; Moses, R.W. (Los Alamos Scientific Lab., NM (USA)). Jan 1980. Contract W-7405-ENG-36. 53p. Dep. NTIS, PC A04/MF A01.

A conceptual DT fusion reactor concept is described that is based upon the dense Z-pinch (DZP). This study emphasizes plasma modeling and the parametric assessment of the reactor energy balance. To this end simple analytic and numerical models have been developed and evaluated. The resulting optimal reactor operating point promises a high-Q, low-yield system of a scale that may allow the use of conventional high-voltage Marx/water-line technology to drive a potentially very small reactor system.

14556 (WFPS-TME—79-022) **Status report on the conceptual design of a commercial tokamak hybrid reactor (CTHR).** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Sep 1979. Contract EG-77-C-02-4544. 166p. Dep. NTIS, PC A08/MF A01.

A preliminary conceptual design is presented for an early twenty-first century fusion hybrid reactor called the Commercial Tokamak Hybrid Reactor (CTHR). This design was developed as a first generation commercial plant producing fissile fuel to support a significant number of client Light Water Reactor (LWR) plants. The study has been made in sufficient depth to indicate no insurmountable technical problems exist and has provided a basis for valid cost estimates of the hybrid plants as well as the hybrid/LWR system busbar electricity costs. This energy system can be optimized to have a net cost of busbar electricity that is equivalent to the conventional LWR plant, yet is not dependent on uranium ore prices or standard enrichment costs, since the fusion hybrid can be fueled by numerous fertile fuel resources.

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 14521

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 14038

14557 (UCB/ERL-M—79/41) **Ergodic orbits in particle simulations of strong ion rings.** Friedman, A. (California Univ., Berkeley (USA). Electronics Research Lab.). 28 Jun 1979. Contract AT03-76ET53064. 41p. Dep. NTIS, PC A03/MF A01.

The existence of ergodic orbits in magnetostatic simulations of strong ion rings is demonstrated. For nonlinear 2D3V simulations with axisymmetry the principal manifestation of such orbits is an eventual violation of left-right mirror symmetry in cases where such symmetry would normally be expected, due to the exponential divergence of neighboring mirror image trajectories. Linearized simulations, in effect, compute the first order separation of orbits which are displaced from each other by an infinitesimal vector for all time. When a linearized code is applied to a problem involving ergodic orbits, the single-particle growth can be faster than that associated with the collective modes of interest, rendering the simulation invalid. This may severely limit the class of problems for which linearized simulation is applicable. Similar effects are expected in simulations of other systems, including field-reversed mirror equilibria with large nominal gyroradii.

14558 (UCRL—82971) **TMX magnet system, present and future.** Wong, R.L.; Pedrotti, L.R.; Leavitt, G.A.; Waugh, A.F.; Chargin, A.K.; Calderon, M.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—95). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The magnetic field design and the mechanical design of the TMX magnet system were previously reported by Chen and Hinkle. This paper is a summary of the work that has been accomplished in the two years since then.

14559 (UCRL—82973) **Beta II field-reversed experiment.** Rubert, R.R.; Bishop, S.R.; Calderon, M.O.; Chargin, A.K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—99). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The purpose of the Beta II experiment is to generate and investigate field-reversed plasmas. To achieve such field configurations, we use a coaxial plasma gun using an internal poloidal field to generate the field-reversed plasma ring. The plasma gun program on Beta II has three steps: producing field-reversed plasma rings, trapping the rings in a magnetic well, and heating and sustaining the rings by neutral-beam injection.

POWER SUPPLIES, ENERGY STORAGE

14560 (LA—7885-MS(Vol.1)) **1-GWh diurnal load-leveling Superconducting Magnetic Energy Storage system reference design.** Rogers, J.D.; Hassenzahl, W.V.; Schermer, R.I. (comps.). (Los Alamos Scientific Lab., NM (USA)). Sep 1979. Contract W-7405-ENG-36. 74p. Dep. NTIS, PC A04/MF A01.

A point reference design has been completed for a 1-GWh Superconducting Magnetic Energy Storage system. The system is for electric utility diurnal load-leveling but can also function to meet much faster power demands including dynamic stabilization. This study explores several concepts of design not previously considered in the same detail as treated here. Because the study is for a point design, optimization in all respects is not complete. This report examines aspects of the coil, the superconductor supported off of the dewar shell, the dewar shell, and its configuration and stresses, the underground excavation and construction for holding the superconducting coil and its dewar, the helium refrigeration system, the electrical converter system, the vacuum system, the guard coil, and the costs. This report is divided into two major portions. The first is a general treatment of the work and the second is seven detailed technical appendices issued as separate reports. The information presented on the aluminum stabilizer for the conductor, on the excavation, and on the converter is based upon industrial studies contracted for this work.

COOLING SYSTEMS

REFER ALSO TO CITATION(S) 14567

HEATING AND FUELING SYSTEMS

14561 (LBL—10081) **Large area negative ion source for high voltage neutral beams.** Poulsen, P.; Hooper, E.B. Jr. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 7p. (CONF-791102—89). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A source of negative deuterium ions in the multi-ampere range is described that is readily extrapolated to reactor size, 10 amp or more of neutral beam, that is of interest in future experiments and reactors. The negative ion source is based upon the double charge exchange process. A beam of positive ions is created and accelerated to an energy at which the attachment process $D + M \rightarrow D^- + M^+$ proceeds efficiently. The positive ions are atomically neutralized either in D_2 or in the charge exchange medium M. Atomic species make a second charge exchange collision in the charge target to form D^-. For a sufficiently thick target, the beam reaches an equilibrium fraction of negative ions. For reasons of efficiency, the target is typically alkali metal vapor; this experiment uses sodium. The beam of negative ions can be accelerated to high (>200 keV) energy, the electrons stripped from the ions, and a high energy neutral beam formed.

14562 (LBL—10155) **Combining magnetic shielding and cryopumping for a neutral beam source.** Tanabe, J.; Green, M.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—98). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

This paper describes a feasible geometry for the shield/cryopump for a TFTR/Doublet type of neutral beam source, summarizes some of the design parameters, and compares the perform-

ance, fabrication, and operating cost of such a system with a more conventional system.

14563 (PPPL—1629) **Technique for measuring cooling patterns in ion source grids by infrared scanning.** Grisham, L.R.; Eubank, H.P.; Kugel, H.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1980. Contract EY-76-C-02-3073. 14p. Dep. NTIS, PC A02/MF A01.

Many plasma sources designed for neutral beam injection heating of plasmas now employ copper beam acceleration grids which are water-cooled by small capillary tubes fed from one or more headers. To prevent thermally-induced warpage of these grids it is essential that one be able to detect inhomogeneities in the cooling. Due to the very strong thermal coupling between adjacent cooling lines and the concomitant rapid equilibration times, it is not practical to make such measurements in a direct manner with a contact thermometer. We have developed a technique whereby we send a burst of hot water through an initially cool grid, followed by a burst of cool water, and record the transient thermal behavior usng an infrared television camera. This technique, which would be useful for any system with cooling paths that are strongly coupled thermally, has been applied to a number of sources built for the PLT and PDX tokamaks, and has proven highly effective in locating cooling deficiencies and blocked capillary tubes.

14564 (UCRL—82874) **Fiber optics in neutral beam control on the TMX experiment at LLL.** Pollock, G.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—102). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The neutral beams on the TMX experiment make extensive use of fiber optics for control and monitoring. Over 200 individual links are used, spanning a wide range of lengths, data rates, and implementation techniques. The objectives of high voltage isolation, EMI immunity and ground loop avoidance were successfully achieved. The fiber optics introduced some problems of their own, principally in mechanical survival of the fibers and in posing subtle interdisciplinary problems to designers. This paper will describe the various types of lines used and their implementation. Problems unique to fiber optics and alternative approaches will be discussed.

14565 (UCRL—82916) **Mechanical design and installation of the TMX injector system.** Lang, D.D.; Calderon, M.O.; Gillespie, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—100). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The injector system for the Tandem Mirror Experiment at Lawrence Livermore Laboratory is used to create, heat and maintain the magnetically-confined, deuterium plasma. This paper extends Calderon's original description of the mechanical aspects of the TMX injector system, and covers new developments now that it is installed and functioning. The startup target plasma is supplied by four titanium-washer-type, streaming-plasma guns. An alternate method of establishing the target plasma has been incorporated, which uses four, 2XIIB electron-beam guns to ionize the deuterium gas supplied by the gas stabilization system. The plasma is heated and maintained by the injection of high-energy, neutral deuterium atoms into the target plasma, where they are ionized, and magnetically confined. These high-energy deuterium atoms are produced by sixteen 20-keV injectors and eight 40-keV injectors. The gas-stabilization system is used to feed cold deuterium gas into the plasma to form a cold plasma sheath that helps stabilize the hot, dense plasma.

14566 (UCRL—82939) **Startup of the TMX neutral beam system.** Wieskamp, T.F.; Mooney, L.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Nov 1979. Contract W-7405-ENG-48. 6p. (CONF-791102—103). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

The beam system and some of the problems encountered and solutions implemented during the construction and start-up are described. We will point out difficulties in going from a prototype test stand to 24 production neutral beam systems installed and operational. We will describe the quality control and maintenance procedures developed in order to achieve system reliability. We will discuss difficulties encountered in adapting commercial equipment for use in the neutral beam system, and we will describe the methodology of approaching interchangeability of components and spare parts inventory. We will discuss problems encountered in protecting the overall TMX against transients produced by the beam system and we will discuss solutions to oscillation problems encountered in TMX. Finally, we will present the more recent operating data for TMX neutral beam system and discuss how it impacts the operation of the rest of the TMX facility.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

14567 (HEDL-SA—1877-FP) **Liquid lithium behavior and control.** Jeppson, D.W. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1979. Contract EY-76-C-14-2170. 11p. (CONF-791103—67). Dep. NTIS, PC A02/MF A01.

From American Nuclear Society meeting; San Francisco, CA, USA (12 Nov 1979).

Tests were conducted on the compatibility of liquid lithium with various gas atmospheres and concretes. Fire extinguishing powders have been tested to determine their effectiveness in extinguishing well established lithium fires. Lithium quantities up 15 kg at temperatures up to 870°C were tested to relate to temperatures encountered in fusion reactor designs. (MOW)

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 14026, 14027, 14029, 14081

14568 (SAND—79-2113C) **PBFA control and monitor system.** Harrison, J.L. (EG and G, Inc., Albuquerque, NM (USA)). Oct 1979. Contract EY-76-C-04-0789. 23p. (CONF-7910118—1). Dep. NTIS, PC A02/MF A01.

From Minicomputer colloquium; Las Vegas, NV, USA (24 Oct 1979).

The Control/Monitor system, built by the Kirtland Operation of EG and G's Energy Measurements Group for Sandia Laboratories' Particle Beam Fusion Accelerator, will use a distributed-microprocessor system interfaced to a minicomputer. The major purpose for the microprocessors and minicomputers is to organize the operation of the accelerator into systematic, preplanned sequences that will maximize the scientific output of the facility.

14569 (SAND—80-0051C) **Pulselac program.** Humphries, S. Jr.; Freeman, J.R.; Kuswa, G.W.; Mendel, C.W.; Poukey, J.W.; Quintenz, J.P. (Sandia Labs., Albuquerque, NM (USA)). 1979. Contract EY-76-C-04-0789. 7p. (CONF-7910122—2). Dep. NTIS, PC A02/MF A01.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The Pulselac Program at Sandia Laboratories is a recent addition to the Heavy Ion Fusion Program. The purpose of this paper is to give a brief introduction to the work performed to date and future plans for the development of high current accelerators. The basis of the program is the investigation of practical methods of neutralizing the space charge of intense ion beams both in accelerating and transport regions. Alleviation of space charge constraints on ion beam transport would open up a broad range of new options for accelerator fusion drivers. The method to be employed is the introduction of electrons from external sources into the volume of the ion beam, allowing the relaxation towards a state of lower potential energy. Both the spatial location and velocity distribution of the electrons must be controlled. Our approach is to utilize weak magnetic fields, which have negligible effect on the ion orbits, to accomplish this. The program has two major goals. The first is to gain an understanding of the general phenomenon of beam neutralization. The second is to demonstrate the technological feasibility of the utilization of these principles to produce multi-kiloampere ion beams in a controlled and reproducible manner.

14570 (SAND—80-0177C) **Research and application of pulsed-power technology.** Yonas, G. (Sandia Labs., Albuquerque, NM (USA)). 12 Jan 1980. Contract EY-76-C-04-0789. 19p. Dep. NTIS, PC A02/MF A01.

Pulsed-power technology relating to that branch which was stimulated by military applications in the 1960's is addressed. A history of the development and characteristics of some devices producing intense electron and ion beams which resulted in Sandia's particle beam fusion program is presented. These include Hermes II, Aurora, Hydra, and Proto II. Research on inertial confinement fusion ignition is described, and the most critical issue in ICF today still is the demonstration of ignition and efficient burnup of a small amount of thermonuclear fuel. Progress on the Sandia particle beam fusion accelerator (PBFA I and II) is reported, but already plans are underway to further upgrade the device and if these modifications are carried out in 1983, fusion ignition concepts may be tested by 1985. Fusion could possibly provide an inexhaustible supply of energy in the next century. (MCW)

14571 (UCRL—50021-78(Vol.1)) **Laser program. Annual report, 1978.** Monsler, M.J.; Jarman, B.D. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 243p. Dep. NTIS, PC A11/MF A01.

An overview of the entire program is given. The overview previews the report, highlights progress in 1978, and summarizes the facilities and resources of the laser program. The Argus, Shiva, and Nova facilities are described. The theory of fusion target design is discussed along with specialized techniques of target fabrication. (MOW)

14572 (UCRL—50021-78(Vol.2)) **Laser program. Annual report, 1978.** Monsler, M.J.; Jarman, B.D. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 254p. Dep. NTIS, PC A12/MF A01.

This volume details the year's experiments, data, and analysis. The technology development programs required for the high performance needed in target diagnostic instrumentation and in solid state laser components are reviewed. (MOW)

14573 (UCRL—50021-78(Vol.3)) **Laser program. Annual report, 1978.** Monsler, M.J.; Jarman, B.D. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1979. Contract W-7405-ENG-48. 266p. Dep. NTIS, PC A12/MF A01.

This volume documents progress in advanced quantum electronics - primarily the quest for advanced rep-rateable short-wavelength lasers with high efficiency. Application studies in electrical energy production and fissile fuel production are also described. Selected highlights of the advanced isotope separation program are also presented. (MOW)

14574 (UCRL—82830) **Measurements of laser parameters for the Shiva laser fusion facility.** Ozarski, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Sep 1979. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

Large laser systems require numerous laser diagnostics to provide configuration, performance and maintenance data to permit efficient operation. The following diagnostics for a large laser system named Shiva are discussed: (1) description of Shiva laser system, (2) what measurements are desired and or required and why, (3) what measurement techniques and packages are employed and a brief description of the operating principles of the sensors employed, and (4) the laser diagnostic data acquisition and display system.

14575 (UCRL—82936) **Hierarchically structured distributed microprocessor network for control.** Greenwood, J.R.; Holloway, F.W.; Rupert, P.R.; Ozarski, R.G.; Suski, G.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Jul 1979. Contract W-7405-ENG-48. 13p. (CONF-7908104—1). Dep. NTIS, PC A02/MF A01.

From 3. Rocky Mountain symposium; Fort Collins, CO, USA (19 Aug 1979).

To satisfy a broad range of control-analysis and data-acquisition requirements for Shiva, a hierarchical, computer-based, modular-distributed control system was designed. This system handles the more than 3000 control elements and 1000 data acquisition units in a severe high-voltage, high-current environment. The control system design gives one a flexible and reliable configuration to meet the development milestones for Shiva within critical time limits.

14576 **Recent progress and plans for heavy ion fusion.** Godlove, T.F. (US DOE, Washington, DC). *IEEE Trans. Nucl. Sci.;* **NS-26**: No. 3, 2997-3001(Jun 1979).

From IEEE particle accelerator conference; San Francisco, CA (12 Mar 1979).

The heavy ion inertial fusion community has completed two years of conceptual designs, cost estimates, theoretical analyses and a modest experimental effort in ion sources and preaccelerators. Designs have narrowed to rf linacs (with storage rings) and induction linacs. Considerable progress has been made in the theory of high current beam handling. Ion sources at levels appropriate to both linac types have been demonstrated. Attention is turning to more detailed accelerator designs appropriate to a three-stage program, the first stage involving demonstration of high current beam techniques, the second stage aimed at ion-pellet deposition experiments, the third stage being a megajoule class pellet driver. In this study progress is reviewed, with emphasis on program implications. 14 refs.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

REFER ALSO TO CITATION(S) 13911, 13912, 13923

14577 (HEDL-SA—1926-FP) **Miniature specimen technology for postirradiation fatigue crack growth testing.** Mervyn, D.A.; Ermi, A.M. (Hanford Engineering Development Lab., Richland, WA (USA)). 13 Nov 1979. Contract EY-76-C-14-2170. 7p. (CONF-791102—92). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

Current magnetic fusion reactor design concepts require that the fatigue behavior of candidate first wall materials be characterized. Fatigue crack growth may, in fact, be the design limiting factor in these cyclic reactor concepts given the inevitable presence of crack-like flaws in fabricated sheet structures. Miniature specimen technology has been developed to provide the large data base necessary to characterize irradiation effects on the fatigue crack growth behavior. An electrical potential method of measuring crack growth rates is employed on miniature center-cracked-tension specimens (1.27 cm x 2.54 cm x 0.061 cm). Results of a baseline study on 20% cold-worked 316 stainless steel, which was tested in an in-cell prototypic fatigue machine, are presented. The miniature fatigue machine is designed for low cost, on-line, real time testing of irradiated fusion candidate alloys. It will enable large scale characterization and development of candidate first wall alloys.

14578 (UCRL—82918) **Vacuum system for the Tandem Mirror Experiment.** Richardson, M.J.; Atkinson, D.P.; Calderon, M.O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Nov 1979. Contract W-7405-ENG-48. 5p. (CONF-791102—94). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

This paper is a sequel to the one prepared by Atkinson, et al., in which the authors described the vacuum system of Lawrence Livermore Laboratory's Tandem Mirror Experiment (TMX). We discuss here the final configuration, liquid nitrogen (LN_2) supply, and operation of the complete TMX vacuum system. The assembled vacuum system consists of two plug tanks with a volume of approximately 60 m^3 each and a center cell tank with a volume of approximately 10 m^3. In each plug tank there are 145 m^2 of titanium-gettered, LN_2-filled panels, which allow a pumping speed calculated to be 5 x 10^7 l/s for a period of 50 ms. The system maintains an operating pressure in the plasma chamber on the order of 10^{-6} Torr while 24 neutral-beam injectors are introducing 700 Torr l/s of hydrogen into the vacuum chamber.

14579 (UWFDM—339) **Limiter pumping system for divertorless tokamaks.** Conn, R.W.; Sviatoslavsky, I.N.; Sze, D.K. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Nov 1979. Contract EY-76-S-02-2272. 7p. (CONF-791102—97). Dep. NTIS, PC A02/MF A01.

From 8. symposium on engineering problems of fusion research; San Francisco, CA, USA (13 Nov 1979).

A specially shaped toroidal belt limiter for high power tokamak systems is developed. The peak heat load is reasonable (~ 200 - 400 W/cm^2), and a water cooling system is presented. A choked gap permits adequate pumping of plasma fuel and ash.

GENERAL AND MISCELLANEOUS

MANAGEMENT

REFER ALSO TO CITATION(S) 13658

14580 (DOE/TIC—11090) **DOE/labor communications network for DOE Region IV. Final report.** (Vachon, Nix and Associates, Norcross, GA (USA)). 31 Oct 1979. Contract EV-78-C-01-6535. 258p. Dep. NTIS, PC A12/MF A01.

The major emphasis of this effort was the planning and establishment of an active network for acquiring and processing energy/labor data into information for dissemination within DOE and to the energy/labor market of DOE Region IV. The network is designed to provide DOE with a feedback system, encourage labor participation in DOE policy development, and allow the assessment of labor response. Following the introductory chapter, Chapter II, DOE Region IV Energy/Labor Communications Network, explains what was accomplished (the energy/labor communications network was developed and put into operation) and the mechanisms involved. Chapter III, Articulation of Energy/Labor Issues, identifies many of the network elements and participants involved in the Power plant and Industrial Fuel Use Act Impact Assessment, the Florida Energy/Labor Forum, and interview sessions. Functions, procedures and responsibilities are discussed and good insight can be gained regarding the results and value of such programs. Chapter IV, Network Development, explains how Vachon, Nix and Associates (VNA) accomplished the development and operation of the energy/labor communications network. This chapter explains VNA's use of the Systematic-Approach in the Development of Institutional Relations with the Labor Community. Chapter V, Conclusions, presents several different conclusions of an on-going effort for the network operation. (MCW)

14581 (LA-UR—80-93) **Why a graduate center in a national laboratory.** Gurbaxani, S.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 3p. (CONF-800112—1). Dep. NTIS, PC A02/MF A01.

From College industry education conference; Tucson, AZ, USA (28 Jan 1980).

Advantages of having a graduate center at a national laboratory and some operational aspects of the center are briefly summarized. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 12911, 14349, 14613, 14616

14582 (COO—2383-0060) **GALMOL: an automatic solver for partial differential equations.** Hsiung, C.C. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Sep 1979. Contract EY-76-S-02-2383. 65p. (UIUCDCS-R—79-977; UILU-ENG—79-1725). Dep. NTIS, PC A04/MF A01.

The GALerkin Method Of Lines code package, GALMOL, is designed to solve parabolic partial differential equations having a single space dimension. It uses either the finite element method or the Gaussian collocation method for space discretizations. A robust ordinary differential equation solver is used as the time integrator; it is very efficient and achieves high accuracy. After introductory material, some theoretical background about the semidiscrete Galerkin method is given. Next, the features and implementation of GALMOL are described, including the structures and different options of the program. Although the input language is largely self-explanatory, a description and a user's guide are provided. The performance and ease of use of the package are illustrated for the heat equation, Burger's equation, and the wave equation. Some typical input and prototype CYBER JCL sequences are given. (RWR)

14583 (LBL—9433) **Proceedings of the fourth Berkeley conference on distributed data management and computer networks.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1979. Contract W-7405-ENG-48. 425p. (CONF-790834—). Dep. NTIS, PC A18/MF A01.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

Individual abstracts were prepared for 19 of the papers in these proceedings. The remaining two have already been cited in ERA, and may be located by reference to the entry CONF-790834—in the Report Number Index. (RWR)

14584 (LBL—9433, pp 75-112) **Effects of concurrency control on the performance of a distributed management system.** Ries, D.R. (Univ. of Califorina, Berkeley). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

Simulation models for four concurrency control algorithms were used to study the effects on a distributed data base. In a distributed data base, the data and transactions are distributed over several computer sites connected through some type of network. Some transactions access data at only one site, while others access data at several of the computer sites. The concurrency control algorithms simulated can be divided into two general classes: primary site control and decentralized control. In the primary site control models, all of the locking takes place at one of the nodes, designated the primary site. Even local transactions (transactions that just access data at their originating sites) must send lock requests to the primary site. In the decentralized control models, the locking of the data items takes place at the site where the data being accessed are stored. In these models, then, local transactions need not send any messages over the computer network. 7 figures,3 tables.

14585 (LBL—9433, pp 113-124) **Concurrency control mechanism for distributed data bases which uses centralized locking controllers.** Garcia-Molina, H. (Stanford Univ., CA). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

A new efficient concurrency control mechanism for distributed data bases is presented. This general concurrency control mechanism is based on the idea of having a centralized locking controller for each replicated fragment of data. The independent centralized controllers operate without explicit backup controllers. A simplified two-phase commit protocol is used to perform updates. In this protocol, only a majority of acknowledgments from the copies of a fragment for the prepare (first-phase) messages is required before the commitment of new data. The major protocols required for the concurrency mechanism are outlined. These include the transaction-cancelling protocol and the new controller election protocol.

14586 (LBL—9433, pp 141-154) **CSMA protocol in local networks.** Lam, S.S. (Univ. of Texas, Austin). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

A consequence of bursty traffic in computer communications is that, among a large population of network users, at any one time only a small number of them have data to send (ready users). In this environment, the performance of an access protocol for a broadcast network depends mainly upon how quickly one of the ready users can be identified and given sole access to the shared channel. The relative merits of the access protocols of polling, probing, and carrier sense multiple access (CSMA) with respect to this channel assignment delay in local networks are considered. A central controller is needed for polling and probing, while CSMA employs distributed control. A specific CSMA protocol is defined which requires that collisions in the channel be detected and that the users involved in a collision abort their transmissions quickly. In addition, it is assumed that the contention algorithm is adaptive and gives rise to a stable channel. An analytic model is developed. The main result is the moment-generating function of the distributed queue size (number of ready users). Mean-value formulas for message delay and channel assignment delay are also derived. The results on queue size and delay are the major contribution of this paper, since they are not available in prior CSMA models in closed analytical form. Numerical results are given to illustrate the performance of the CSMA protocol. When the channel utilization is light to moderate, the mean channel assignment delay of the CSMA protocol is significantly less than that of both polling and probing; consequently, the mean message delay is much smaller. It is also shown that, when queuing of messages is permitted at individual users, the maximum channel throughput of CSMA approaches unity in th limit of very long queues. 4 figures.

14587 (LBL—9433, pp 155-178) **Global and local models for the specification and verification of distributed systems.** Gouda, M.; Boyd, D.; Wood, W. (Honeywell Corp. Technology Center, Minneapolis, MN). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

Two models for the specification of distributed systems are presented: global and local models. The global model can be used to specify the system requirements without suggesting any specific design to achieve these requirements. The local model can be used to specify some particular system designs that satisfy the given requirements. Some general verification techniques are proposed to prove theorems about the specifications in both models. The two models are used to specify a number of well-known distributed systems such as shared-resource systems, schedulers, readers and writers, and the five dining philosophers. The proposed verification techniques are also applied to some of these systems.

14588 (LBL—9433, pp 179-188) **Protocols for dating coordination.** Cohen, D.; Yemini, Y. (USC/Information Sciences Inst., Marina del Rey, CA). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

The process of specifying protocols for computer communication is examined. A dating coordination protocol is used as an example for an interprocess communication. Since this problem has some timing constraints built into it, the resulting discussion is different from that regarding most of the more familiar protocols, which do not have requirements associated with timing. Several protocols are discussed in order to illustrate different aspects of the specification issue.

14589 (LBL—9433, pp 207-220) **Concurrency control in a multiple copy distributed data base system.** Lin, W.T.K. (Sperry Research Center, Sudbury, MA). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

The concurrency control mechanism employed by the System for Distributed Data Bases, SDD-1, avoids both central site control and global data locking. Modifications to the concurrency control mechanism of SDD-1 are proposed which eliminate the need for timestamps on data items and weaken the constraints of some of the read-write protocols. These modifications reduce the amount of storage required and allow accommodation of existing data bases which may make no provision for stored data item timestamps. A new protocol, W, is introduced which requires that write actions which participate in certain cycles in the class conflict graph be synchronized at certain sites. This protocol may reduce the degree of concurrency supported by the system. Existing SDD-1 protocols are augmented with weaker forms of these protocols that allow more flexibility in scheduling read and write actions under certain conditions. Timestamps of some actions are allowed to be changed in order to reduce the synchronization delay experienced by other actions, to increase concurrency. A proof of correctness is given. 5 figures, 3 tables.

14590 (LBL—9433, pp 221-234) **New concurrency control algorithm for distributed data base systems.** Minoura, T. (Stanford Univ., CA). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

A new concurrency control algorithm for distributed data base systems that spatially extends the idea of exclusive/share locks is presented. The new algorithm, extended true-copy token algorithm, combines a locking mechanism and a true-copy token mechanism. True-copy tokens handle partitioned data that cannot be handled efficiently by locks alone. 3 figures.

14591 (LBL—9433, pp 237-259) **Synchronization of distributed simulation using broadcast algorithms.** Peacock, J.K.; Manning, E.; Wong, J.W. (Univ. of Waterloo, Ontario). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

Simulation, particularly of networks of queues, is an application with a high degree of inherent parallelism, and is of considerable practical interest. The analysis of synchronization methods for distributed simulation, defined by the taxonomy in earlier work is continued. Specifically, algorithms are developed for time-driven simulation using a network of processors. For most of the synchronization methods considered, each node, k, of an n-node network simulation cannot proceed directly with its part of a simulation. Rather, it must compute some function B/sub k/(v_1,v_2 ... , v/sub n/), where v/sub i/ is some value which must be obtained from node i. The value of v/sub i/ at each node changes as the simulation progresses, and must be broadcast to every other node for the recomputation of the B functions. In some cases, it is advantageous to compute the B function in a distributed manner. Broadcast algorithms for such distributed computation are presented. Since the performance of a broadcast algorithm depends on the properties of the interprocess communication facility, particular cases are characterized and algorithms for each of them are given. 5 figures.

14592 (LBL—9433, pp 260-274) **Updating protocol of the ARPANET's new routing algorithm:: a case study in maintaining identical copies of a changing distributed data base.** Rosen, E.C. Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

In May 1978 a new routing algorithm was installed in the ARPANET. In this algorithm, each network node makes an independent routing decision, based on information about delays throughout the network. The delay on a particular line is measured at the nodes attached to that line, and disseminated to the rest of the network in the form of a routing update. One aspect of the routing algorithm is discussed here, viz. its updating protocol (i.e., the protocol used to disseminate the updates). The problem of devising a good updating protocol is shown to be a problem in the management of a distributed data base. The requirements that any such protocol must meet in order to be satisfactory are presented and discussed. The protocol is then developed so as to meet these requirements. Other possible protocols are discussed and shown not to meet the requirements.

14593 (LBL—9433, pp 275-283) **NIC name server: a datagram based information utility.** Pickens, J.R.; Feinler, E.J.; Mathis, J.E. Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

A new method for distributing and updating host name/address information in large computer networks is described. The technique uses datagrams to provide a simple transaction-based query/response service. A provisional service is being provided by the Arpanet Network Information Center (NIC) and is used by mobile packet radio terminals, as well as by several Arpanet DEC-10 hosts. Extensions to the service are suggested that would expand the query functionality to allow more flexible query formats as well as queries for service addresses. Several architectural approaches with potential for expansion into a distributed internet environment are proposed. This technique may be utilized in support of other distributed applications, such as user identification and group distribution for computer-based mail.

14594 (LBL—9433, pp 309-321) **Labeled slot multiplexing: a technique for a high speed, fiber optic based, loop network.** Blauman, S. (TRW Communications Group, Torrance, CA). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

A high-speed, fiber optic-based, ring-structured, local computer network is described. The TTL-based prototype system operates at a line rate of 20 Mbps. The interface logic has been specified to allow implementation in the faster ECL components, which could operate at line rates to 200 Mbps. The loop interface mates the high-speed fiber optic channel to its relatively slow computer elements through a technique called Labeled Slot Multiplexing (LSM). The byte-multiplexed LSM loop is nonhierarchial and asynchronous, requiring no host computer or line supervisor. Agents on the loop contend for space nondestructively, placing byte packets on the line only when space is available. Time slots on the loop are not predetermined, and packets may be inserted whenever space exists. Address recognition is implemented at the line level, and provides for both functional and physical addresses. Up to 63 devices may share the loop, with a potential for 192 logical functions. The loop interface is modular, separated into two logical/physical packages, a line interface and a processor interface. The line interface contains only the logic which must function at line rates, with the slower, byte-oriented operations performed in the less expensive processor interface. 2 figures.

14595 (LBL—9433, pp 322-336) **Distributed file manager for the TRW Experimental Development System.** Danforth, S. (TRW, Redondo Beach, CA). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

Since 1976, the Computer Engineering Section at TRW has been using Concurrent Pascal in its multiple-minicomputer Signal Processing Facility for research into the software engineering of special-purpose locally distributed systems. In such systems, the particular operating system support required at any processor can be quite specific, this specificity removing the necessity for use of typical vendor-supplied general-purpose operating systems. With the aid of appropriate Concurrent Pascal code segments, complete operating system environments that exactly match local processing requirements can be easily constructed. Intercomputer link drivers, file systems, graphics packages, and performance monitors are examples of typical services. To these was added a simple distributed file manager (DFM), which maintains three possible levels of access control for a file distributed redundantly over any number of machines. The particular services or application code interfaces into the DFM that were decided upon, the operation of the manager and its representation as a collection of Concurrent Pascal system types, and a method of monitoring its performance are discussed. 2 figures.

14596 (LBL—9433, pp 337-352) **Network support for a distributed data base system.** Rowe, L.A.; Birman, K.P. (Univ. of California, Berkeley). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

COCANET is a local computer network being developed, in part, to support distributed data base system research. A multidestination, or multicast, protocol is provided to satisfy the communication requirements of the INGRES distributed data base system. These requirements include sending messages to a dynamically varying subset of processes. Efficient implementation of the multicast protocol in a local broadcast network is described. In addition, internetwork support of the protocol is discussed. COCANET extends a conventional UNIX programing environment across multiple processors by supporting transparent resource sharing and message-oriented interprocess communication mechanisms. 7 figures.

14597 (LBL—9433, pp 353-375) **Transaction processing in the distributed DBMS-POREL.** Fauser, U.; Neuhold, E.J. (Univ. of Stuttgart, Germany). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

A short description of the architecture of the DDBMS-POREL currently being implementing at the University of Stuttgart is given first. Then the transaction processing control, the Execution Monitor, which at run time is responsible for the administration and control of the transaction flow in the network, is studied in some detail. Each transaction in the DBMS is associated with a specific Execution Monitor that completely supervises its processing and initiates and executes the necessary synchronization, resource handling, and recovery preparation. 4 figures.

14598 (LBL—9433, pp 376-416) **ESA: an evolutionary system architecture for a distributed data base management system.** Weber, H.; Baum, D.; Popescu-Zeletin, R. (Hahn-Meitner-Inst., Berlin, Germany). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

A distributed data management system on a heterogeneous computer network is presented. It consists of two components: a front-end system composed of a number of application-specific data base management functions and a general-purpose kernel. This architecture was developed to provide for system evolution upon changes of user requirements, for simplicity of the system structure, and for a high system performance. The paper elaborates on the rationale for the approach. It encompasses a description of the gross architecture of the system, reflects on the most critical design issues for distributed data management systems on heterogeneous computer networks, and explains the solutions developed. 18 figures.

14599 (LBL—10189/3) **FTN4 optimization techniques.** Friedman, R. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1979. Contract W-7405-ENG-48. 28p. Dep. NTIS, PC A03/MF A01.

Both the optimizations that the compiler performs for the user and those the user can embody in the source code are described. Most of these optimizations decrease central processor time (not always at the expense of field length), but some decrease field length, input/output time, real time, or throughput. The best way to optimize code is to use efficient algorithms. The higher the level at which a program is optimized, the better the results. 1 table. (RWR)

14600 (LBL—10409(DRAFT)) **Array processors in chemistry.** Ostlund, N.S. (Arkansas Univ., Fayetteville (USA). Dept. of Chemistry; California Univ., Berkeley (USA). Lawrence Berkeley Lab.).

Jan 1980. Contract W-7405-ENG-48. 63p. Dep. NTIS, PC A04/MF A01.

The field of attached scientific processors ("array processors") is surveyed, and an attempt is made to indicate their present and possible future use in computational chemistry. The current commercial products from Floating Point Systems, Inc., Datawest Corporation, and CSP, Inc. are discussed.

14601 (LTSS—307(Ed.3)) **Livermore timesharing system. Part 4: library files. Chapter 307: mathematics and statistics software library catalog.** Basinger, R.C.; Greenbaum, A.; Jepson, M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Nov 1979. Contract W-7405-ENG-48. 110p. Dep. NTIS, PC A06/MF A01.

A library of mathematical and statistical routines maintained by the Laboratory's Mathematics and Statistics Section is described, and instructions for users of the LLL Computer Facility to obtain the source programs in this library are given. Brief descriptions of the routines are included.

14602 (ORNL/CSD—51) **TES: a program for simulating phase change processes.** Solomon, A.D.; Serbin, C.A. (Oak Ridge National Lab., TN (USA)). Jan 1980. Contract W-7405-ENG-26. 253p. Dep. NTIS, PC A12/MF A01.

The purpose and use of the computer program TES is for the simulation of a phase change process in a material due to heat input or extraction at its surface. The program arose from the need for a simulation tool in latent heat thermal energy storage modeling, and owes much to the questions stimulated by this important field. (GHT)

14603 (UCID—18494(Pt.4)) **Conflict Simulation Laboratory-II, Part 4. Standard implementation plan.** Ames, H.S.; Bly, S.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Dec 1979. Contract W-7405-ENG-48. 14p. Dep. NTIS, PC A02/MF A01.

The Conflict Simulation Laboratory provides graphic and computational tools to model nuclear combat through simulated tactical battlefields and war games. Limitations of present equipment are noted, and a new hardware-software system is proposed. Estimated costs, scheduling, justification of need, and similar administrative information are given. 1 figure, 2 tables. (RWR)

14604 (UCID—18507) **Displaying the results of three-dimensional analysis using GRAPE. Part one: vector graphics.** Brown, B.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1979. Contract W-7405-ENG-48. 117p. Dep. NTIS, PC A06/MF A01.

GRAPE is a display program for three-dimensional polygon and polyhedral models. It can produce line-drawing and continuous-tone black and white or color images in still frame or movie mode. The code was written specifically to be a post-processor for finite element and finite difference analyses. It runs on the CDC 7600 computer, and is compiled with the LLL FTN system. The allocation of storage is dynamic. There are presently three data paths into the code. The first is the binary inerface from the analyses codes and this with the other databases is described. The second data path is the SAMPP format, and the last is the MOVIE format. The code structure is described first; then the commands are discussed in general terms to try to give the user some feel for what they do. The next section deals with the exact format of the commands by overlay. Then examples are given and discussed. Next, the various output options are covered. 57 figures. (RWR)

14605 (UCID—18526) **Multiprocessor connection schemes.** Lawver, B.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1980. Contract W-7405-ENG-48. 37p. Dep. NTIS, PC A03/MF A01.

Multiprocessor connection schemes are surveyed, and research in the area of parameterizing these schemes is proposed. A multiprocessor is a set of processing elements that are able to cooperate in the execution of a computation, with the goals of improved performance and lower cost. Several multiprocessor organizations are examined, the connections of these multiprocessor organizations are explored, and a model that emphasizes multiprocessor connections is introduced. 23 figures, 1 table. (RWR)

14606 (UCID—30175(Rev.1)) **Array processing for FORTRAN.** Wetherell, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Jan 1980. Contract W-7405-ENG-48. 69p. Dep. NTIS, PC A04/MF A01.

The Special Task Force on Cray FORTRAN (STF) was chartered to consider ...new language features to exploit the vector hardware of the CRAY-1 that might also be applicable to other large scientific computers. The new array processing features in STF FORTRAN provide access to the computing power of vector machines in a way which is easy for the programmer to write, easy for others to read, and easy for compilers to process. Array processing for FORTRAN means that most of the operations in FORTRAN that may be done for ordinary scalar variables may also be done for arrays. In addition, features for selecting sections of arrays, for packing and unpacking arrays, for using arrays as procedure arguments, and for using arrays with generic functions are provided by STF FORTRAN. Simple array objects are introduced first, and the basic definitions necessary for the discussion are made. Next, methods for the construction of array expressions are described and the array assignment statement is defined. A new coercion, broadcasting of scalars, is explained. The ideas of array shape and extent are reexamined and enlarged, and the class of array objects is widened to include several kinds of array sections (slices). Conditional array assignment and array packing and unpacking are discussed next; the operations are tied together in their usage. The use of arrays with procedures is described, both old and new generic functions are defined as applied to arrays. This is a reference manual. It does contain some examples and illustrations of usage, but they should not be taken as suggesting either appropriate or efficient usage of any features. This is not a user's manual. 16 figures 3 tables. (RWR)

14607 (UCRL—52877) **Establishing criteria for selection of personnel to work on interactive graphics system.** Norton, F.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Aug 1979. Contract W-7405-ENG-48. 216p. Dep. NTIS, PC A10/MF A01.

Thesis.

Criteria for selection of personnel to work on interactive graphics systems and human behavioral patterns that are created by the implementation of graphics systems are considered. Some of the social and educational problems associated with interactive graphics systems are discussed. (RWR)

14608 (UCRL—83702) **S-1 Project: developing high-performance digital computers.** Widdoes, L.C. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Dec 1979. Contract W-7405-ENG-48. 12p. (CONF-800201—5). Dep. NTIS, PC A02/MF A01.

From COMPCON 1980; San Francisco, CA, USA (25 Feb 1980).

A multiprocessor (the S-1) with at least ten times the computational power of the Cray-1 is being designed and implemented. The first step is to develop a general-purpose uniprocessor with a performance level comparable to the Cray-1; the multiprocessor will then be made up of 16 of these uniprocessors, sharing a main memory. The uniprocessors can be used together for large problems or separately for several smaller problems. To reduce average memory-access time, each uniprocessor has a private cache memory. A powerful design system (SCALD) that supports extremely efficient structured design of digital logic was also developed. Using advanced compiler and verification techniques, SCALD can complete the details of a computer design starting from a high-level specification. 5 figures, 1 table.

14609 (UCRL—83730) **Optimal use of a vector processor.** Sinz, K.H.P.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Dec 1979. Contract W-7405-ENG-48. 6p. (CONF-800201—6). Dep. NTIS, PC A02/MF A01.

From COMPCON 1980; San Francisco, CA, USA (25 Feb 1980).

It is always possible to construct a machine that has execution rates one or two orders of magnitude greater than the memory speeds. A machine can overcome the speed of light or switching speeds with increased parallelism. One implication of such a stratagem would be a CDC STAR-100-like machine that is speeded up by possibly a factor of 40 to 100. Whether the resulting somewhat rigid programing requirements permit the full utilization of such parallelism is discussed in several applications. For example, matrix transposition can always proceed at rates greater than memory speeds. It will also be seen that best algorithms are not unique. They are problem-dependent and often rely on iteration. Many more problems are fully vectorizable than is immediately apparent, but considerable analysis may be required.

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 13224, 13695, 14580, 14583, 14584, 14590, 14597, 14598

14610 (DOE/EIA—7013-1) **DFI Computer Modeling Software (CMS) .** Cazalet, E.G.; Deziel, L.B. Jr.; Haas, S.M.; Martin, T.W.; Nesbitt, D.M.; Phillips, R.L. (Decision Focus, Inc., Palo Alto, CA (USA)). Oct 1979. 310p. Dep. NTIS, PC A14/MF A01.

The data base management system used to create, edit and store models data and solutions for the LEAP system is described. The software is entirely in FORTRAN-G for the IBM 370 series of computers and provides interface with a commercial data base system SYSTEM-2000.

14611 (DOE/TIC—4579-R10(Suppl.7)) **Energy information data base. Serial titles: Supplement 7, February 1978-December 1979.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Dec 1979. 137p. Dep. NTIS, PC A07/MF A01.

This supplement contains changes and additions to TID-4579-R10 (the authority list for serial titles used by the DOE Technical Information Center), and is intended for use with that publication. Supplements are cumulative from February 1978 until another revision is issued.

14612 (DOE/TIC—4585-R1(Suppl.4)) **Energy information data base. Corporate author entries: Supplement 4, June 1978-December 1979.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Dec 1979. 57p. Dep. NTIS, PC A04/MF A01.

This supplement contains additions to TID-4585-R1 (the authority list for corporate author names used by TIC), and is intended for use with that publication. Supplements are cumulative from June 1978 until another revision is issued.

14613 (LBL—9433, pp 3-17) **XNDM: an experimental network data manager.** Kimbleton, S.R.; Wang, P.S.C.; Fong, E.N. (National Bureau of Standards, Washington, DC). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

Data base access is increasingly important in a networking environment. Two alternative approaches can be identified: implementation of distributed data bases presenting the user with one logical data base implemented across a collection of computers or, alternatively, development of network data managers providing a uniform user and program veiwpoint across heterogenous DBMSs. While the first approach is the most natural extension of the concept of an individual DBMS, its utilization imposes certain requirements, including the necessity for converting existing DBMSs if their data are to be supported in the distributed environment. The second approach minimizes or eliminates conversion problems; however, it has not yet been shown feasible. This paper describes a research project concerned with establishing the feasibility, issues, alternatives, and a techincal approach for supporting a network data manager, although implementation has not been completed, the initial evidence is positive and suggests that network data managers may well prove either an acceptable alternative or useful intermediate stage to a distributed data base. 2 figures, 1 table.

14614 (LBL—9433, pp 51-71) **ADAPT data translation system and applications.** Bach, M.J.; Goguen, N.H.; Kaplan, M.M. Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

The ADAPT (A DAta Parsing and Transformation) system provides an efficient generalized language-driven approach toward data translation. Its high-level languages are easily learned and understood. The data descriptions and transformations can be easily modified as the conversion requirements evolve. It provides transformations on an interrecord level as well as the power of standard text editors for intrarecord transformations. ADAPT has other uses besides that of a one-time data translation. Since the process of data conversion may cover a long time frame, logically consistent copies of the source and target data bases must be maintained. The ADAPT system can be used as a tool to insure consistency of the source and target data bases, even if they exist on different machines. Another use of the ADAPT system is in a distributed data base context. Logical records that are distributed to different nodes of the data base can be collected by ADAPT and presented as a single physical record to a user at one node. This paper presents a functional overview of the ADAPT system and discusses applications of the ADAPT system to computer network problems. 2 figures.

14615 (LBL—9433, pp 125-137) **Efficient monitoring of data base assertions in distributed data bases.** Badal, D.Z. (Univ. of Califorina, Los Angeles). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

A principal problem with the use of data base integrity assertions for monitoring the integrity of a dynamically changing data base is the high cost due to the evaluation of such assertions. The cost and performance of several integrity validation methods are analyzed and compared in a distributed data base environment where the communication cost and delay are principal factors.

14616 (LBL—9433, pp 191-206) **Distributed control of updates in multiple-copy data base: a time optimal algorithm.** Ramirez, R.J.; Santoro, N. (Univ. of Waterloo, Ontario). Aug 1979.

From 4. Berkeley workshop on distributed data management and computer networks; Berkeley, CA, USA (28 Aug 1979).

The problem of updating a data base with multiple copies under distributed control is addressed. An update synchronization algorithm for data bases whose copies are distributed on a store-and-forward synchronous network is presented, and its complexity is analyzed. The proposed algorithm is shown to be time optimal within an additive constant for networks of arbitrary topology. The algorithm incorporates a simple priority scheme to resolve concurrent updates. 3 figures.

14617 (ORNL/TM—7126) **Rigorous, systematic approach to automatic data editing and its statistical basis.** Liepins, G.E. (Oak Ridge National Lab., TN (USA)). Feb 1980. Contract W-7405-ENG-26. 36p. Dep. NTIS, PC A03/MF A01.

Automatic data editing is the computerized identification and correction (optional) of data errors. These techniques can provide error statistics that indicate the frequency of various types of data errors, diagnostic information that aids in identifying inadequacies in the data collection system, and a clean data base appropriate for use in further decision making, in modeling, and for inferential purposes. However, before these numerous benefits can be fully realized, certain research problems need to be resolved, and the linkage between statistical error analysis and extreme-value programing needs to be carefully determined. The linkage is provide here for the special case that certain independence and symmetry conditions obtain; also provided are rigorous proofs of results central to the functioning of the Boolean approach to automatic data editing of coded (categorical) data. In particular, sufficient collections of edits are defined, and it is shown that for a fixed objective function the solution to the fields to impute problem is obtainable simply from knowing which edits of the sufficient collection are failed, and this solution is invariant of the particular sufficient collection of edits identified. Similarly, disjoint-sufficient collections of edits are defined, and it is shown that, if the objective function of the fields to impute problem is determined by what Freund and Hartley call the number of involvements in unsatisfied consistency checks, then the objective function will be independent of the disjoint-sufficient collection of edits used.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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EC-77-C-05-5623	**Research Triangle Inst., Research Triangle Park, NC (USA)**	
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EC-77-S-02-4493	**Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering**	
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EC-77-S-02-4531	**Institute of Gas Technology, Chicago, IL (USA)**	
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EE-77-S-02-4364	**Niagara Univ., NY (USA)**	
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EF-76-C-01-2514	**Lummus Co., Bloomfield, NJ (USA)**	
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EF-77-A-01-2893	**Exxon Research and Engineering Co., Florham Park, NJ (USA)**	
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EF-77-C-01-2468	**Engineering Societies Commission on Energy, Inc., Washington, DC (USA)**	
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EF-77-C-01-2566	**UOP, Inc., Des Plaines, IL (USA). Corporate Research Center**	
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EF-77-C-01-2582	**Memphis Light, Gas and Water Div., TN (USA)**	
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EF-77-C-01-2588	**Amoco Oil Co., Naperville, IL (USA). Research and Development Dept.**	
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EF-77-G-01-2745	**Arizona Univ., Tucson (USA). Dept. of Chemical Engineering**	
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EF-77-S-01-2666	**Brigham Young Univ., Provo, UT (USA). Dept. of Chemical Engineering**	
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EF-77-S-01-2722	**West Virginia Univ., Morgantown (USA). Coll. of Mineral and Energy Resources**	
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EF-77-S-01-2727	**Mississippi Univ., University (USA). Dept. of Chemical Engineering**	
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EF-77-S-01-2729	**Brigham Young Univ., Provo, UT (USA)**	
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EF-77-S-02-4246	**Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science**	
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EG-77-A-03-1510	**Michaud, Cooley, Hallburg, Erickson, and Associates, Inc., Minneapolis, MN (USA)**	
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EG-77-C-01-4015	**Hamilton Standard, Windsor Locks, CT (USA)**	
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EG-77-C-01-4042	**Solar Energy Research Inst., Golden, CO (USA)**	
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EG-77-C-01-4049	**Boeing Aerospace Co., Seattle, WA (USA)**	
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EG-77-C-02-4388	**Dynatech R/D Co., Cambridge, MA (USA)**	
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EG-77-C-02-4544	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.**	
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EG-77-C-02-4643	**Solar Environmental Engineering Co., Inc., Fort Collins, CO (USA)**	
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EG-77-C-03-1329	**Desert Hot Springs, City of, CA (USA)**	
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EG-77-C-03-1468	**General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.**	
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EG-77-C-03-1483	**Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group**	
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EG-77-C-03-1570	**TRW Systems and Energy, Redondo Beach, CA (USA)**	
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EG-77-C-03-1577	**Westinghouse Research and Development Center, Pittsburgh, PA (USA)**	
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EG-77-C-04-3985	**General Electric Co., Philadelphia, PA (USA). Advanced Energy Dept.**	
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EG-77-C-06-1040	**Oregon State Dept. of Geology and Mineral Industries, Portland (USA)**	
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EG-77-C-07-1650	**Terra Tek, Inc., Salt Lake City, UT (USA)**	
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EG-77-G-03-1617	**Hawaii Univ., Honolulu (USA). Dept. of Meteorology**	
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EG-77-S-02-4264	**Pennsylvania State Univ., University Park (USA). Dept. of Computer Science**	
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EG-77-S-02-4518	**Colorado State Univ., Fort Collins (USA). Dept. of Electrical Engineering**	
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EG-77-X-01-3891	**Stanford Univ., CA (USA). Dept. of Civil Engineering**	
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EL-78-C-01-7151	**Kavernen Bau- und Betriebs, G.m.b.H., Hannover (Germany, F.R.)**	
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EM-78-C-01-5226	**American Inst. of Industrial Engineers, Norcross, GA**	
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EM-78-C-02-4977	**Public Service Electric and Gas Co., Newark, NJ (USA)**	
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EM-78-C-02-4979	**Toledo Edison Co., OH (USA)**	
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EM-78-C-05-5759	**General Electric Co., Schenectady, NY (USA)**	
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EM-78-G-01-5143	**Dutchess County Pyrolysis Project, Poughkeepsie, NY (USA)**	
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EM-78-G-02-4664	**Solar Systems of Virginia, Inc., Hampton (USA)**	
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EM-78-G-02-4665	**Solar Systems of Virginia, Inc., Hampton (USA)**	
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EM-78-S-02-4719	**Middlebury Coll., VT (USA)**	
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EN-77-C-01-6139	**RAND Corp., Santa Monica, CA (USA)**	
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EN-77-C-02-4057	**General Electric Co., Schenectady, NY (USA)**	
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EN-77-S-02-4570	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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EN-78-C-02-4954	**United Engineers and Constructors, Inc., Philadelphia, PA (USA)**	
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ER-78-C-02-4996	**GTE Labs., Inc., Waltham, MA (USA)**	
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ES-77-C-02-4275	**Avco-Everett Research Lab., Inc., Everett, MA (USA)**	
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ET-76-C-01-9040	**Engineers International, Inc., Downers Grove, IL (USA)**	
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ET-77-C-01-9125	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
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ET-78-A-03-2208	**Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.**	
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ET-78-C-01-2645	**UOP, Inc., Des Plaines, IL (USA). Corporate Research Center**	
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ET-78-C-01-2652	**Pope, Evans and Robbins, Inc., New York (USA)**	
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ET-78-C-01-2778	**Pullman Kellogg, Houston, TX (USA)**	
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ET-78-C-01-3210	Suntech, Inc., Marcus Hook, PA (USA)	
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ET-78-C-02-4931	Deep Oil Technology, Inc., Long Beach, CA (USA)	
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ET-78-C-02-5035	Little (Arthur D.), Inc., Cambridge, MA (USA)	
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ET-78-C-03-1864	Science Applications, Inc., La Jolla, CA (USA)	
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ET-78-C-03-1865	Combustion Electromagnetics, Inc., Lexington, MA (USA)	
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ET-78-C-03-1876	RCA Labs., Princeton, NJ (USA)	
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ET-78-C-03-1890	Systems Exploration, Inc., San Diego, CA (USA)	
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ET-78-C-03-2219	RCA Labs., Princeton, NJ (USA)	
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ET-78-C-03-2226	Aerospace Corp., Los Angeles, CA (USA). Energy and Resources Div.	
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ET-78-C-05-3054	Southern Co. Services, Inc., Birmingham, AL (USA)	
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ET-78-C-07-1702	Westinghouse Electric Corp., Baltimore, MD (USA). Electronic Products and Services Div.	
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ET-78-G-01-3215	American Society for Testing and Materials, Philadelphia, PA	
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ET-78-G-02-4709	Western Minnesota Municipal Power Agency, Detroit Lakes (USA)	
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ET-78-G-03-2175	California Energy Commission, Sacramento (USA)	
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ET-78-G-05-5958	RPC, Inc., Austin, TX (USA)	
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ET-78-S-01-3411	George Washington Univ., Washington, DC (USA). School of Engineering and Applied Science	
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ET-78-S-02-4649	Iowa State Univ. of Science and Technology, Ames (USA). Heat Transfer Lab.	
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ET-78-S-05-5669	Temple Univ., Philadelphia, PA (USA). Dept. of Chemistry	
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ET-78C-03-2121	JM Energy Consultants, Inc., Los Angeles, CA (USA)	
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EU-78-G-01-4172	Illinois Inst. of Natural Resources, Springfield (USA)	
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EV-78-C-01-6535	Vachon, Nix and Associates, Norcross, GA (USA)	
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EW-78-A-02-4755	Missouri Univ., Rolla (USA)	
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EW-78-A-21-8450	Physical Sciences, Inc., Woburn, MA (USA)	
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EW-78-C-02-4740	Management and Technical Services Co., Clairton, PA (USA)	
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EW-78-C-02-5011	Portland Cement Association, Skokie, IL (USA). Construction Technology Labs.	
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EW-78-C-05-6038	Hayes, Seay, Mattern and Mattern, Roanoke, VA (USA)	
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EW-78-C-06-1076	Battelle Human Affairs Research Center, Seattle, WA (USA)	
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EW-78-C-21-8385	Columbia Gas System Service Corp., Columbus, OH (USA)	
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EW-78-C-51-0261	Mathematical Sciences Northwest, Inc., Bellevue, WA (USA)	
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EW-78-S-22-0234	East Tennessee State Univ., Johnson City (USA). Dept. of Environmental Health	
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EX-76-A-01-2295-026	Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.	
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EX-76-A-29-1012	Jet Propulsion Lab., Pasadena, CA (USA)	
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EX-76-A-29-1028	Kaman Aerospace Corp., Bloomfield, CT (USA)	
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EX-76-A-29-1037	General Electric Co., Philadelphia, PA (USA). Space Div.	
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EX-76-A-29-1060	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
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EX-76-A-36-1008	Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.	
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EX-76-A-1010-005	National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center	
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EX-76-C-01-1545	**Combustion Engineering, Inc., Windsor, CT (USA)**	
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EX-76-C-01-2006	**Utah Univ., Salt Lake City (USA). Dept. of Mining and Fuels Engineering**	
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EX-76-C-01-2007	**Johns-Manville Sales Corp., Denver, CO (USA)**	
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EX-76-C-01-2029	**Purdue Univ., Lafayette, IN (USA). Combustion Lab.**	
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EX-76-C-01-2247	**Texaco, Inc., Montebello, CA (USA). Montebello Research Lab.**	
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EX-76-C-01-2274	**West Virginia Univ., Morgantown (USA). Dept. of Chemical Engineering**	
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EX-76-C-01-2434	**Institute of Gas Technology, Chicago, IL (USA)**	
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EX-76-C-01-2553	**South Dakota School of Mines and Technology, Rapid City (USA)**	
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EX-76-S-01-2537	**Oklahoma State Univ., Stillwater (USA). Dept. of Chemistry**	
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EY-76-A-03-0959	**Jet Propulsion Lab., Pasadena, CA (USA)**	
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EY-76-A-08-0539	**Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring and Support Lab.**	
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EY-76-C-02-1195	**Illinois Univ., Urbana (USA)**	
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EY-76-C-02-1198	**Illinois Univ., Urbana (USA). Digital Computer Lab.**	
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EY-76-C-02-1428	**Purdue Univ., Lafayette, IN (USA). Dept. of Physics**	
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EY-76-C-02-2616	**Grumman Aerospace Corp., Bethpage, NY (USA). Research Dept.**	
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EY-76-C-02-2676	**General Electric Co., Schenectady, NY (USA)**	
	5:13585	GEFR-SP—170
EY-76-C-02-2681	**Hydronautics, Inc., Laurel, MD (USA)**	
	5:13338	COO—2681-3
EY-76-C-02-2705	**General Electric Co., Philadelphia, PA (USA)**	
	5:13381	COO—2705-3
EY-76-C-02-2708-026	**National Academy of Sciences, Washington, DC (USA)**	
	5:14477	DOE/CH/93026—1
EY-76-C-02-2817	**Sperry Research Center, Sudbury, MA (USA)**	
	5:13425	COO—2817-T1
EY-76-C-02-2861	**Loftus Furnace Co., Pittsburgh, PA (USA)**	
	5:13793	COO—2861-2
EY-76-C-02-2939	**Toronto Univ., Ontario (Canada). Dept. of Mechanical Engineering**	
	5:13634	DOE/CS/32939—7
EY-76-C-02-3000	**Fermi National Accelerator Lab., Batavia, IL (USA)**	
	5:14089	FERMILAB—80/1
EY-76-C-02-3073	**Princeton Univ., NJ (USA). Plasma Physics Lab.**	
	5:14527	MATT—1(Suppl.8)
	5:14532	PPPL—1623
	5:14533	PPPL—1631
	5:14541	PPPL—1608
	5:14542	PPPL—1619
	5:14543	PPPL—1626
	5:14544	PPPL—1634
	5:14551	PPPL—1635
	5:14563	PPPL—1629

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EY-76-C-02-3490	**Rochester Univ., NY (USA). Dept. of Radiation Biology and Biophysics**	
	5:14270	UR—3490-1790
	5:14291	UR—3490-1787
EY-76-C-02-4048	**Bell Telephone Co. of Pennsylvania, Philadelphia (USA)**	
	5:13352	DOE/CS/4048—2
EY-76-C-02-4094	**Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.**	
	5:13302	COO—4094-71
	5:13303	COO—4094-73
EY-76-C-03-0012	**California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology**	
	5:14266	UCLA—12-1231
	5:14267	UCLA—12-1233
	5:14282	UCLA—12-1230
	5:14288	UCLA—12-1234
EY-76-C-03-0472	**California Univ., Davis (USA). Radiobiology Lab.**	
	5:14294	UCD—472-125
EY-76-C-03-0515	**Stanford Univ., CA (USA)**	
	5:14463	COO—1545-269
EY-76-C-03-1012	**California Univ., San Francisco (USA)**	
	5:14260	CONF-7909115—1
EY-76-C-03-1093	**Hawaii Univ., Honolulu (USA). Hawaii Inst. of Geophysics**	
	5:13341	HIG—79-6
	5:13391	HIG—78-6
	5:13397	SAN—1093-T5
	5:13405	SAN—1093-T6
EY-76-C-03-1095	**AiResearch Mfg. Co., Phoenix, AZ (USA)**	
	5:13784	SAN—1095-T2
EY-76-C-03-1109	**Honeywell, Inc., St. Petersburg, FL (USA). Avionics Div.**	
	5:13326	SAN—1109-79-2
EY-76-C-03-1246	**FMC Corp., Santa Clara, CA (USA). Engineered Systems Div.**	
	5:13324	DOE/ET/20426—1
EY-76-C-04-0053	**Mound Facility, Miamisburg, OH (USA)**	
	5:13197	MLM—2683
	5:14021	MLM—2242(Rev.1)
EY-76-C-04-0613	**Bendix Corp., Kansas City, MO (USA)**	
	5:14007	BDX—613-2311
	5:14008	BDX—613-2376
EY-76-C-04-0656	**Hazleton-Nuclear Science Corp., Palo Alto, CA (USA). Radiochemistry Dept.**	
	5:13905	GEPP-OP—474
	5:13979	GEPP-TIS—470
EY-76-C-04-0789	**Sandia Labs., Livermore, CA (USA)**	
	5:12935	SAND—79-8730
	5:13107	SAND—79-2389
	5:13144	SAND—79-2262
	5:13148	SAND—79-1245
	5:13172	SAND—79-0988C
	5:13173	SAND—79-0989C
	5:13174	SAND—79-2141
	5:13188	SAND—79-2242/1
	5:13189	SAND—79-7037
	5:13290	SAND—79-2345A
	5:13291	SAND—80-0112C
	5:13292	SAND—80-0170C
	5:13315	SAND—80-0110C
	5:13316	SAND—80-0111C
	5:13385	SAND—79-1802
	5:13426	SAND—79-1756C
	5:13427	SAND—79-2398
	5:13588	NUREG/CR—0987
	5:13603	NUREG/CR—0944
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	5:13614	SAND—79-2020C
	5:13892	SAND—79-1740
	5:13919	SAND—78-1694
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	5:14004	SAND—79-8285
	5:14128	SAND—79-0259
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	5:14568	SAND—79-2113C
	5:14569	SAND—80-0051C
	5:14570	SAND—80-0177C
EY-76-C-04-3533	**Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant**	
	5:13157	RFP—2972
	5:13480	RFP—2920/3533/78/6-1
	5:13481	RFP—2920/3533/78/6-2
EY-76-C-05-0033	**Oak Ridge Associated Universities, Inc., TN (USA)**	
	5:13007	DOE/IR—0056
	5:13011	ORAU—155
	5:13662	ORAU/IEA—79-23(M)
	5:13682	ORAU/IEA—79-20(M)
	5:13683	ORAU/IEA—79-21(M)
	5:13695	DOE/TID/0033—1
EY-76-C-05-5135	**West Virginia Univ., Morgantown (USA). Dept. of Aerospace Engineering**	
	5:13479	ORO—5135-77/1
EY-76-C-05-5194	**West Virginia Univ., Morgantown (USA). Dept. of Geology and Geography**	
	5:13083	ORO—5194-T1
	5:13084	ORO—5194-T2
	5:13085	ORO—5194-T5
EY-76-C-06-1830	**Battelle Pacific Northwest Labs., Richland, WA (USA)**	
	5:13026	PNL—3183
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	5:13131	PNL—2080-16
	5:13132	PNL—2985
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	5:13156	PNL—3050-2
	5:13162	ONWI—9(3)
	5:13164	PNL—3070
	5:13165	PNL-SA—7184
	5:13166	PNL-SA—7197
	5:13181	PNL—2286
	5:13194	PNL—3165
	5:13333	SERI/TR—8043-(Vol.1)
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	5:13562	PNL—3249
	5:13563	PNL-SA—7503
	5:13564	PNL-SA—7521
	5:13595	PNL—2286(App.)
	5:13613	PNL-SA—7771
	5:13629	PNL—3231
	5:13665	PNL—3091
	5:13694	PNL-SA—7020
	5:13742	PNL—3087
	5:13897	PNL-SA—6698
	5:13923	PNL—3228
	5:13995	PNL-SA—7640
	5:14155	PNL-SA—7515
	5:14156	PNL-SA—7587
	5:14190	PNL-SA—7549
	5:14243	PNL—3160-1
	5:14389	PNL-SA—7218(Rev.)
	5:14444	ONWI—21
EY-76-C-06-1857	**UNC Nuclear Industries, Inc., Richland, WA (USA)**	
	5:13599	UNI-SA—77
	5:14133	UNI—1318
EY-76-C-07-1540	**Idaho National Engineering Lab., Idaho Falls (USA)**	
	5:13435	IDO—1540-T2
EY-76-C-07-1570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
	5:13433	CONF-800210—1
	5:13548	EGG/LTR-LO—00-79-110
	5:13596	EGG—2006
	5:13600	EGG/YBR—11-80
	5:13606	NUREG/CR—1145
	5:13797	IDO—1570-T21
	5:13951	EGG-PHYS—5058
	5:14522	IDO—1570-T32
EY-76-C-08-0685	**Petroleum Technology Corp., Redmond, WA (USA)**	
	5:13093	NVO—0685
EY-76-C-08-1183	**EG and G, Inc., San Ramon, CA (USA). Energy Measurements Group**	
	5:13551	UCRL—15155
	5:13926	EGG—1183-1717(Rev.1)
	5:14145	EGG—1183-1757
EY-76-C-09-0001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	5:13151	DPST—79-294
	5:13195	DPST—79-128-1/2
	5:13196	DPST—79-128-3/4
	5:13598	DP—1529
	5:13932	DP—1546

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EY-76-C-11-0014	Bettis Atomic Power Lab., West Mifflin, PA (USA)	
	5:13565	WAPD-TM—1336
	5:13566	WAPD-TM—1412
	5:13567	WAPD-TM—1426
EY-76-C-13-1664	Los Alamos Scientific Lab., NM (USA)	
	5:13120	GJBX—3(80)
	5:13121	GJBX—6(80)
	5:13122	GJBX—17(80)
	5:13123	GJBX—22(80)
	5:13952	GJBX—4(80)
EY-76-C-14-2170	Hanford Engineering Development Lab., Richland, WA (USA)	
	5:13139	HEDL-TC—1331
	5:13140	HEDL-TME—78-58
	5:13559	HEDL-SA—1839
	5:13581	HEDL-TME—79-13
	5:13914	DOE/TIC—11086
	5:14567	HEDL-SA—1877-FP
	5:14577	HEDL-SA—1926-FP
EY-76-S-02-1156	Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology	
	5:14227	COO—1156-117
EY-76-S-02-1367	Northwestern Univ., Evanston, IL (USA)	
	5:13913	COO—1367-109
EY-76-S-02-2026	Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science	
	5:13990	COO—2026-39
EY-76-S-02-2086	Wayne State Univ., Detroit, MI (USA). Dept. of Chemistry	
	5:13994	COO—2086-90
EY-76-S-02-2272	Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering	
	5:14579	UWFDM—339
EY-76-S-02-2383	Illinois Univ., Urbana (USA). Dept. of Computer Science	
	5:14582	COO—2383-0060
EY-76-S-02-2446	Chicago Univ., IL (USA). Enrico Fermi Inst.	
	5:13384	EFI—79-42
EY-76-S-02-2529	Columbia Univ., Palisades, NY (USA). Lamont-Doherty Geological Observatory	
	5:14241	COO—2529-12
EY-76-S-02-2584	Cornell Univ., Ithaca, NY (USA)	
	5:13889	COO—2584-3
EY-76-S-02-2588	Wisconsin Univ., Madison (USA). Solar Energy Lab.	
	5:13348	COO—2588-T1
EY-76-S-02-2706	Northwestern Univ., Evanston, IL (USA). Dept. of Physics	
	5:14484	COO—2076-5
EY-76-S-02-2807	Kansas State Univ., Manhattan (USA). Dept. of Chemistry	
	5:13991	COO—2807-15
	5:13992	COO—2807-17
EY-76-S-02-2814	Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Biochemistry	
	5:14305	COO—2814-5
EY-76-S-02-2868	Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.	
	5:13349	COO—2868-5
EY-76-S-02-3496	Rochester Univ., NY (USA). Dept. of Chemistry and Physics	
	5:14501	COO—3496-73
EY-76-S-02-3501	Rochester Univ., NY (USA). School of Medicine and Dentistry	
	5:14295	COO—3501-13
EY-76-S-02-4114	Massachusetts Inst. of Tech., Cambridge (USA)	
	5:14274	COO—4115-46
EY-76-S-05-3408	Hahnemann Medical Coll. and Hospital, Philadelphia, PA (USA)	
	5:14304	CONF-790229—4
EY-76-S-05-3956	Tennessee Univ., Knoxville (USA)	
	5:14090	ORO—3956-9
EY-76-S-05-5075	Houston Univ., TX (USA)	
	5:13053	BETC—5075-2
EY-76-S-05-5126	Maryland Univ., College Park (USA). Dept. of Physics and Astronomy	
	5:14513	ORO—5126-97
EY-76-S-05-5206	New York State Museum and Science Service, Albany (USA)	
	5:13082	METC/EGSP—100
EY-76-S-06-2227-036	Oregon State Univ., Corvallis (USA)	
	5:13434	DOE/ET/28469—4
EY-76-S-06-2229-007	Alaska Univ., College (USA). Geophysical Inst.	
	5:13420	RLO—2229-T7-2
EY-76-S-06-2342	Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering	
	5:13444	DOE/ET/20283—1
EY-77-C-06-1030	Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations	
	5:13134	RHO-LD—74
	5:13147	RHO-LD—79-101-D
	5:13167	RHO-BWI—79-100
	5:13168	RHO-BWI-C—47
	5:13169	RHO-BWI-LD—22
	5:13170	RHO-CD—810
	5:13171	RHO-CD—896
	5:13227	RHO-CD—829
	5:14219	RHO-SA—121
EY-77-C-09-1001	Babcock and Wilcox Co., Lynchburg, VA (USA)	
	5:13138	BAW—1484-7
EY-77-C-21-8085	TRW, Inc., McLean, VA (USA). Energy Systems Planning Div.	
	5:12932	METC—8085-T2
EY-77-S-06-2438	Environmental Technology Assessment, Inc., Oak Brook, IL (USA)	
	5:13488	RLO—2438-77/2
FC-7-79ID12016	Utah Div. of Water Rights, Salt Lake City (USA)	
	5:13409	DOE/ID/12016—1
FG02-79R510117	General Plastics Corp., Marion, IN (USA)	
	5:13729	COO—10117-1
FG02-79R510157	Department of Energy, Washington, DC (USA)	
	5:13770	DOE/R5/10157—1
NAS-7-100-954334	Union Carbide Research Inst., Tarrytown, NY (USA)	
	5:13255	DOE/JPL/954334—9
	5:13256	DOE/JPL/954334—10
	5:13257	DOE/JPL/954334—11
NAS-7-100-954343	Lamar Univ., Beaumont, TX (USA). Dept. of Chemical Engineering	
	5:13258	DOE/JPL/954343—79/16
NAS-7-100-954344	South Carolina Univ., Columbia (USA). Coll. of Engineering	
	5:13259	DOE/JPL/954344—1
NAS-7-100-954355	Mobil Tyco Solar Energy Corp., Waltham, MA (USA)	
	5:13260	DOE/JPL/954355—2
NAS-7-100-954471	SRI International, Menlo Park, CA (USA)	
	5:13261	DOE/JPL/954471—11
NAS-7-100-954521	Spire Corp., Bedford, MA (USA)	
	5:13262	DOE/JPL/954521—10
NAS-7-100-954589	Westinghouse Electric Corp., Trafford, PA (USA). Power Circuit Breaker Div.	
	5:13263	DOE/JPL/954589—8
NAS-7-100-954847	Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group	
	5:13264	DOE/JPL/954847—4
NAS-7-100-954862	Aerochem Research Labs., Inc., Princeton, NJ (USA)	
	5:13265	DOE/JPL/954862—7
NAS-7-100-954873	Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center	
	5:13266	DOE/JPL/954873—7
NAS-7-100-954882	MB Associates, San Ramon, CA (USA)	
	5:13267	DOE/JPL/954882—19
NAS-7-100-954886	Siltec Corp., Menlo Park, CA (USA)	
	5:13268	DOE/JPL/954886—7
NAS-7-100-955089	Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.	
	5:13269	DOE/JPL/955089—4
NAS-7-100-955131	Silicon Technology Corp., Oakland, NJ (USA)	
	5:13270	DOE/JPL/955131—1
NAS-7-100-955149	Burt, Hill, Kosar, Rittlemann, and Associates, Butler, PA (USA)	
	5:13306	DOE/JPL/955149—1
NAS-7-100-955266	Sensor Technology, Inc., Chatsworth, CA (USA)	
	5:13271	DOE/JPL/955266—1
NAS-7-100-955270	Kayex Corp., Rochester, NY (USA)	
	5:13272	DOE/JPL/955270—2
NAS-7-100-955282	Siltec Corp., Menlo Park, CA (USA)	
	5:13273	DOE/JPL/955282—1
	5:13274	DOE/JPL/955282—79/2
NAS-7-100-955287	Kulicke and Soffa Industries, Inc., Horsham, PA (USA)	
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NAS-7-100-955298	**Spectrolab, Inc., Sylmar, CA (USA)**	
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NAS-7-100-955307	**Solarex Corp., Rockville, MD (USA)**	
	5:13277	DOE/JPL/955307—2
NAS-7-100-955325	**ARCO Solar, Inc., Chatsworth, CA (USA)**	
	5:13278	DOE/JPL/955325—1
NAS-7-100-955387	**Motorola, Inc., Phoenix, AZ (USA). Semiconductor Group**	
	5:13279	DOE/JPL/955387—1
W-31-109-ENG-38	**Kansas State Univ., Manhattan (USA). Dept. of Chemical Engineering**	
	5:12908	CONF-791108—15
	5:13130	ANL—78-76
	5:13150	ANL/EIS—11
	5:13183	CONF-791117—20
	5:13240	CONF-7809197—
	5:13297	DOE/EV—0064
	5:13379	ANL—79-102
	5:13558	ANL/ENG—80-02
	5:13574	DOE/NE—0003/1
	5:13575	DOE/NE—0003/2
	5:13576	DOE/NE—0003/3
	5:13577	DOE/NE—0003/4
	5:13578	DOE/NE—0003/5
	5:13580	DOE/NE—0003/7
	5:13610	NUREG/CR—1252
	5:13792	ANL/OEPM—78-6
	5:13807	ANL/CNSV-TM—25
	5:13810	ANL/CNSV-TM—27
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	5:14020	CONF-791103—69
	5:14032	ANL—79-103
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W-31-109--ENG-38	**Science Applications, Inc., La Jolla, CA (USA)**	
	5:14159	CONF-7809192—
W-31-109-ENG-38	**Argonne National Lab., IL (USA)**	
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	5:14510	ANL/NDM—50
W-7405-ENG-26	**Oak Ridge National Lab., TN (USA)**	
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	5:13095	ORNL/TM—7083
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	5:13129	Y/DA—6671
	5:13152	K—2007
	5:13163	ORNL—5578
	5:13176	Y/OWI/TM—37
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	5:13546	EPRI-NP—1248
	5:13560	ORNL/TM—7043
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	5:13575	DOE/NE—0003/2
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	5:13578	DOE/NE—0003/5
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	5:13612	ORNL/TM—7086
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	5:14497	CONF-800114—2
	5:14503	CONF-800213—8
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W-7405-ENG-36	**Los Alamos Scientific Lab., NM (USA)**	
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	5:13160	LA—8230-MS
	5:13185	LA—8125-PR
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	5:14017	LA—8111
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	5:14037	LA-UR—80-172
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	5:14114	LA—8165-MS
	5:14117	LA—8084
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	5:14125	LA-UR—80-278
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1	5:14155	*See* PNL-SA-7515
CONF-790602-	(ANS annual meeting, Atlanta, GA, USA, 3-8 Jun 1979)	
92	5:13564	*See* PNL-SA-7521
CONF-790638-	(3. annual biomass energy systems conference, Golden, CO, USA, 5-7 Jun 1979)	
	5:13216	*See* SERI/TP-33-285
CONF-790651-	(National conference on synchrotron radiation instrumentation, Gaithersburg, MD, USA, 4-6 Jun 1979)	
8	5:14087	*See* BNL-26936
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4	5:14554	*See* UCRL-82480
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2	5:14455	*See* COO-4264-9
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3	5:14156	*See* PNL-SA-7587
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3	5:14499	*See* LBL-10356
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3	5:13636	*See* UCRL-83881
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33	5:13890	*See* LBL-10007
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1	5:13358	*See* LBL-9371
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1	5:14575	*See* UCRL-82936
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3	5:13928	*See* BNL-27014
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1	5:14015	*See* UCRL-83334
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1	5:13585	*See* GEFR-SP-170
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1	5:13980	*See* ISM-255
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26	5:13357	*See* LBL-9294
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2	5:14120	Dep. NTIS, PC A03/MF A01
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4	5:13614	*See* SAND-79-2020C
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1	5:14238	*See* BNL-27089
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1839	5:13559	Dep. NTIS, PC A02/MF A01
1877-FP	5:14567	Dep. NTIS, PC A02/MF A01
1926-FP	5:14577	Dep. NTIS, PC A02/MF A01
HEDL-TC-		
1331	5:13139	Dep. NTIS, PC A02/MF A01
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78-58	5:13140	Dep. NTIS, PC A04/MF A01
79-13	5:13581	Dep. NTIS, PC A05/MF A01
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78-6	5:13391	Dep. NTIS, PC A04/MF A01
79-6	5:13341	Dep. NTIS, PC A04/MF A01
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1540-T2	5:13435	Dep. NTIS, PC A03/MF A01
1570-T21	5:13797	Dep. NTIS, PC A05/MF A01
1570-T32	5:14522	Dep. NTIS, PC A02/MF A01
1702-T2	5:13400	Dep. NTIS, PC A06/MF A01
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5-209	5:13635	Dep. NTIS (US Sales Only), PC A03/MF A01
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79/02	5:13677	*See* CONS-4172-T1
IMMR-		
38-PD21-78	5:13697	$7.50
INEL-tr-		
43	5:13949	Dep. NTIS, PC A02/MF A01
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4983	5:13586	Dep. NTIS (US Sales Only), PC A03/MF A01
INKA-Conf-		
79-275-001	5:13010	Dep. NTIS (US Sales Only), PC A03/MF A01
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253	5:14035	Dep. NTIS, PC A03/MF A01
255	5:13980	Dep. NTIS, PC A03/MF A01
JACKFAU-		
78-159-2	5:13763	Dep. NTIS, PC A08/MF A01
JAPFNR-		
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72976	5:14134	Paper copy also available on standing order, deposit account required, North American Continent price, $7.00/each issue, all others write for quote.
K-		
2007	5:13152	Dep. NTIS, PC A09/MF A01
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4420(Rev.2)	5:13127	Dep. NTIS, PC A04/MF A01
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131	5:13124	Dep. NTIS, PC E06/MF E06
LA-		
7510-MS	5:13120	*See* GJBX-3(80)
7585-PR	5:14451	Dep. NTIS, PC A14/MF A01
7871-PR	5:13099	Dep. NTIS, PC A03/MF A01
7885-MS(Vol.1)	5:14560	Dep. NTIS, PC A04/MF A01
7931-PR	5:13159	Dep. NTIS, PC A03/MF A01
7966	5:14465	Dep. NTIS, PC A02/MF A01
7981	5:13948	Dep. NTIS, PC A02/MF A01
7987-MS	5:14107	Dep. NTIS, PC A02/MF A01
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8039-MS	5:13023	Dep. NTIS, PC A02/MF A01
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8063-MS	5:14370	Dep. NTIS, PC A02/MF A01
8083	5:13916	Dep. NTIS, PC A02/MF A01
8084	5:14117	Dep. NTIS, PC A02/MF A01
8086-MAP	5:14446	Dep. NTIS, PC A03/MF A01
8099-MS	5:14377	Dep. NTIS, PC A02/MF A01
8111	5:14017	Dep. NTIS, PC A02/MF A01
8113-MS	5:14516	Dep. NTIS, PC A03/MF A01
8125-PR	5:13185	Dep. NTIS, PC A03/MF A01
8143-T	5:14261	Dep. NTIS, PC A10/MF A01
8146-MS	5:13953	Dep. NTIS, PC A02/MF A01
8160-PR	5:13587	Dep. NTIS, PC A07/MF A01
8165-MS	5:14114	Dep. NTIS, PC A02/MF A01
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8175-PR	5:13125	Dep. NTIS, PC A02/MF A01
8180-PR	5:14224	Dep. NTIS, PC A03/MF A01
8186-MS	5:14555	Dep. NTIS, PC A04/MF A01
8192-MS	5:13933	Dep. NTIS, PC A05/MF A01
8196-MS	5:14262	Dep. NTIS, PC A02/MF A01
8199-PR	5:13628	Dep. NTIS, PC A03/MF A01
8201-MS	5:14519	Dep. NTIS, PC A03/MF A01
8230-MS	5:13160	Dep. NTIS, PC A02/MF A01
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79-2607	5:13186	Dep. NTIS, PC A02/MF A01
79-3298	5:14162	Dep. NTIS, PC A02/MF A01
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80-56	5:14135	Dep. NTIS, PC A03/MF A01
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80-102	5:14500	Dep. NTIS, PC A02/MF A01
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80-172	5:14037	Dep. NTIS, PC A02/MF A01
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LASL-		
78-30	5:13356	Los Alamos Scientific Lab., P.O. Box 1663, Los Alamos, NM 87545
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6865	5:13733	Dep. NTIS, PC A04/MF A01
7448	5:14254	Dep. NTIS, PC A05/MF A01
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7448	5:14286	Dep. NTIS, PC A05/MF A01
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10286	5:13036	Dep. NTIS, PC A05/MF A01
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10356	5:14499	Dep. NTIS, PC A03/MF A01
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10409(DRAFT)	5:14600	Dep. NTIS, PC A04/MF A01
LBL-publ-		
253	5:14450	Univ. of California, Berkeley
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10787-31	5:13103	Dep. NTIS, PC A08/MF A01
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79/9	5:13110	Dep. NTIS, PC A02/MF A01
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79-16850	5:13767	NTIS, PC A14/MF A01
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79-17327	5:13723	NTIS, PC A04/MF A01
79-17330	5:13644	NTIS, PC A04/MF A01
79-17335	5:13721	NTIS, PC A03/MF A01
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79-26221	5:13829	NTIS, PC A04/MF A01
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2106	5:13440	Dep. NTIS, PC A20/MF A01
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012	5:13680	*See* DOE/EIA-0035/12(78)
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004	5:13064	Paper copy also available on subscription, North American Continent price, $36.00/year; all others write for quote.
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017	5:14279	NTIS, PC A04/MF A01
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0060-SUP-1	5:14352	NTIS, PC A02/MF A01
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0944	5:13603	Dep. NTIS, PC A04/MF A01
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1035	5:13605	Dep. NTIS, PC A04/MF A01
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1147	5:13714	Dep. NTIS, PC A05/MF A01
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7091	5:13561	Dep. NTIS, PC A03/MF A01
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3054-T3(App.D)	5:12967	Dep. NTIS, PC A12/MF A01
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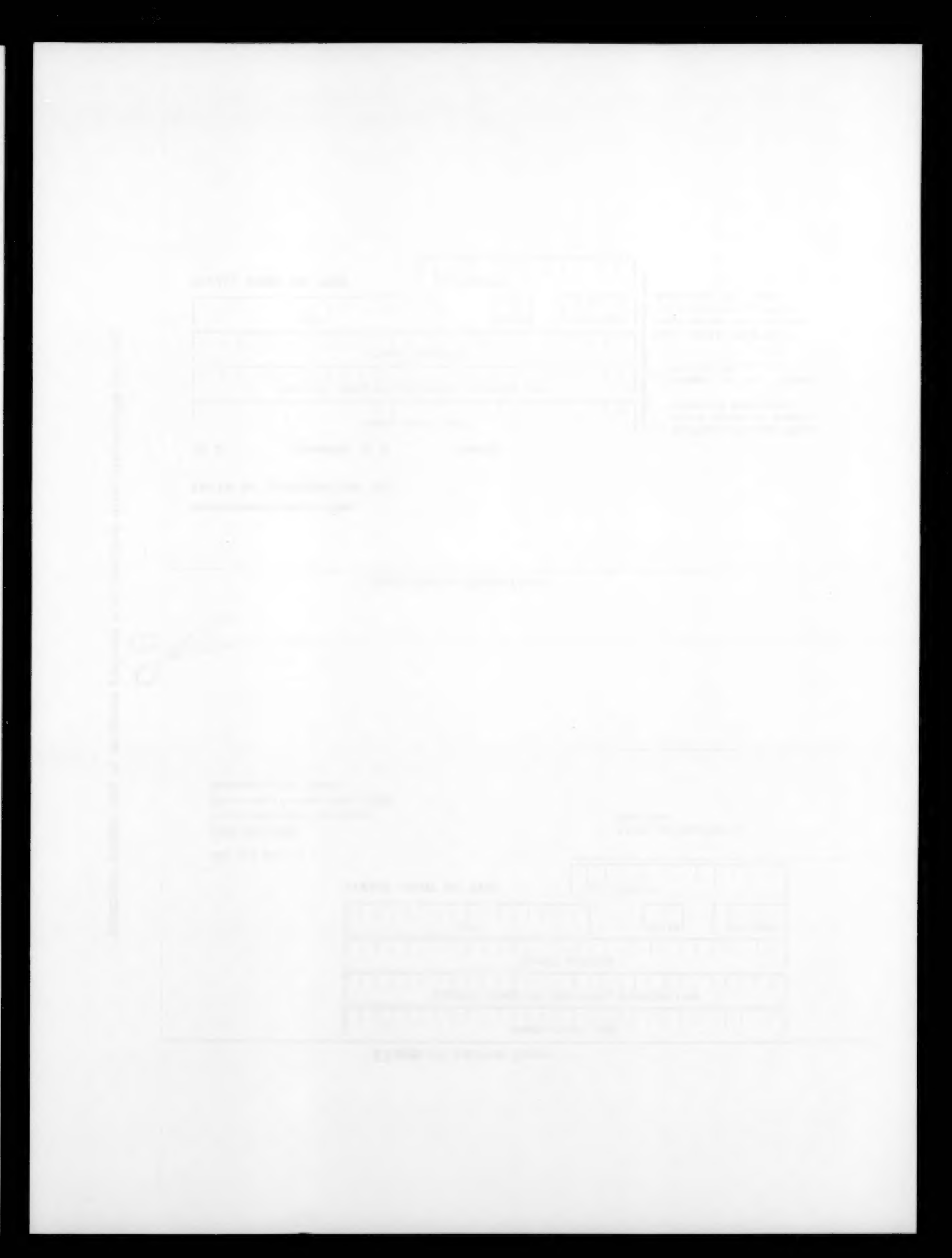

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